

AVIATION WEEK

DEC. 28, 1953

50 CENTS

A MCGRAW-HILL PUBLICATION

Grumman

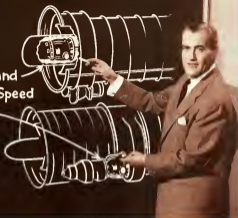
A PLOT OF AIR HISTORY... The U.S. Navy tracks aircraft on a transparent board as radar reports their positions. Plot the most famous Navy and Marine fighter planes as reported by history, and Grumman aircraft fill the board.

GRUMMAN AIRCRAFT ENGINEERING CORPORATION
BETHPAGE • LONG ISLAND • NEW YORK

DESIGNERS AND BUILDERS ALSO OF THE ALBATROSS TRIPHIBIAN AND S2F-1 SUB-KILLER

Nose cone or waist gear box mounting

Sundstrand
Constant Speed
Drive



How Sundstrand helps solve design problems



Small "Package-Type" Drive—can be used as power source for small aircraft and power plant.



Small "Package-Type" Drive—can be used as power source for small aircraft and power plant.



Small "Package-Type" Drive—can be used as power source for small aircraft and power plant.

Variety of application is a prime feature of today's aircraft accessories. Each can replace such new engine problems as the integration of a Constant Speed Drive which will best suit the application.

To meet varying requirements, Sundstrand engineers have evolved three basic types of Constant Speed Drives: the Package type, the Sundstrand type and the Conventional type. These three basic types can be adapted to many model configurations which permit application to the nose cone pod, a gear box pod, or

integrally with the engine gear box.

To allow further flexibility in application, Sundstrand Drives are now being designed to utilize the engine oil system. When required to solve applications, an independent oil system is provided.

There are examples of Sundstrand's contribution to solving design problems involved in the installation of a constant frequency system on the modern airplane. Any time you can use Sundstrand's design team, you help solve your own power generation problem, and free to call upon us.



**SUNDSTRAND
AIRCRAFT
HYDRAULICS**

SUNDSTRAND MACHINE TOOL CO.
HYDRAULIC DIVISION, ROCKFORD, ILL.



THE NEW DOUGLAS DC-7

Here's the big, handsome, DC-7—Douglas' latest commercial airplane. This picture shows off the power packages built for the DC-7 by Rohr... world's largest producer of ready-to-install power packages for both commercial and military planes. In addition, Rohr Aircraft Engines currently are producing more than 25,000 different parts for all types of airplanes.

power packages by

ROHR

WORLD'S LARGEST PRODUCER



OF READY-TO-INSTALL POWER PACKAGES FOR AIRPLANES

ROHR
AIRCRAFT CORPORATION

CHULA VISTA AND RIVERSIDE, CALIFORNIA

Domestic

Silently \$56 two-engine Martin aircraft helicopter was airborne for the first time Dec. 18 and made a low-altitude flight of about 15-min duration Dec. 21. The copter has a five-blade main rotor and a tail rotor, its skid landing gear during high-speed forward flight.

Fallout of a portion of the turbine in the No. 2 Wright Turbo Compound engine of a *Boeing Stearman* DC-7 during start of takeoff Dec. 21 caused the flight to be aborted. The turbine failure set off the transport's fire warning system, and the pilot bailed the plane with broken and inoperable pumps. There was no visible fire. All 50 passengers and five crew members were evacuated. The DC-7 had been delivered two hours prior to takeoff because fire warning system in the No. 2 engine did not respond to pushlight tests. A Wright Aeronautical spokesman declined comment on the accident but said company engineers were investigating.

United Air Lines goes strong backing to a new 5.7-cm. wavelength (C-band) over-the-horizon (O-band) for use in airborne warfare warning radar. This first official company statement on UAL's contention of tests of an experimental RCA radar confirms an *Airweek* Wire prediction (Sept. 26, p. 84). Detailed UAL report on the radar is expected within a month.

New aviation flights from Detroit and Chicago to London will be inaugurated by Pan American World Airways Apr. 30, *Eng. Digest* DC-8 transports on the weekly service. TWA plans to expand routes from the Midwest cities next year with flights to Frankfurt, Stockholm, Hamburg, Garmen, Copenhagen and Stockholm.

Record traffic of more than 1 million passengers is predicted by Texas World Airlines for 1955, topping last year's total by higher than 20%. TWA reports preliminary figures indicate an increase of nearly 24% in average passenger miles, with tourist services being credited with the sharpest climb of 30.5%.

Whitcomb, B-26, 55, passenger carrier and based elsewhere of Ziff Davis Publishing Co., died last week in New York.

Vice Adm. Charles E. Rosenthal (USN Ret.), longtime proponent of draghobies, released the atomic power



Eisenhower Awards Aviation Trophies

President Eisenhower (second from right) chats with TWA's executive vice president, Harold G. Hobbins, (third from left) following presentation of top aviation award for 1954 at the Wright Memorial Dinner in Washington, D. C. Dec. 17. From left to right: Dr. Leslie Brown, University of Illinois, winner of the Frank C. Brown Trophy for aviation training and educational achievements; Hobbins, winner of the Collier Trophy for his work on the B-70; Robert H. Coffey, president of the National Aeronautics Assn.; Eisenhower; and Ray Carl Henson, winner of the Wright Brothers Memorial Trophy. (Story on Wright Dinner on p. 16.)

plant and into our very adaptable aircraft in flight, then we seek. He envisions the airplane as most practical for lifting heavy nuclear engines and utilizing energy from changes of solubility. (Associated Press) told the New York Chapter of Aviation Writers Assn. he believes light-weight titanium can replace fabric as covering for airplanes to increase their strength.

Airframe gas load resistance is being cut from 4 to 3 cc. by Elco Standard Oil Co. in fuel grades 91/95 and 108/110, a move intended to reduce load feeling effect.

Financial

McDonnell Aircraft Co., St. Louis, reports third loading of \$525 million, expects this year's revenue to increase its work force by approximately 5,000 persons within the next 18 months.

Eastern Air Freight Corp., has declared a semi-annual dividend of 38 cents per share, payable Jan. 4 to stockholders of record Dec. 31.

Internationally

First Flight Boeing B-70, 2 to all of assembly lines at Astoria, Wash. Boeing Aircraft's Everett plant has completed flight tests.

U.S. Military, Israel's director of civil

aviation, is looking over U. S. jet fighters during a three-month study tour sponsored by International Civil Aviation Organization. Gatten would be sent for training purposes. Military says.

Texas-Australia Airlines reports a profit of approximately \$307,000 for its first fiscal year, compared with a loss of \$167,000 during the previous 12-month period. Gross revenues for the year more than \$16.8 million.

Boeing Type 175 two-engine, twin-tail helicopter has completed a series of tests on the H-19C Eagle, Britain's largest aircraft carrier. Engineers of the test unit to collect data on rotor behavior under varying conditions of deck motion. Tests were made by Boeing Aerospace Co. for its own development, with the Royal Navy acting as a co-operating agency.

Air traffic transactions put through International Air Transport Assn.'s London clearing house set record totals of \$28,884,600 in September and \$21,625,000 in October, IATA reports. Cumulative turnover during the first 10 months of 1955: 201,650,000.

French civil aviation development will require new investments totaling approximately \$571 million during the next five years, reports René Lewnez, secretary general for civil and commercial aviation in France.



Forgings for the aircraft industry today demand the utmost in engineering and production techniques and in scientific laboratory control. This massive complicated landing gear component, weighing over 400 pounds, is typical of Wyman-Gordon's forging contribution to the ever-growing progress in aircraft design. In crankshafts for the automotive industry and in all types of aircraft forgings, steel and light alloy, Wyman-Gordon has pioneered in the development of forging "know-how"—there is no substitute for Wyman-Gordon experience.

Standard of the Industry for More Than Sixty-five Years

WYMAN-GORDON
FORGINGS OF ALUMINUM • MAGNESIUM • STEEL
WORCESTER, MASSACHUSETTS
HARVEY, ILLINOIS DETROIT, MICHIGAN

Another **SCHWEIZER**
PRODUCTION
ASSIST
FOR ...

VERSATILE
PERFORMANCE

The Schweizer reputation for quality standards, production ability and the facilities for both sub-contract work and the manufacture of Schweizer's internationally famous sailplanes is widely recognized and relied upon. When you need a production assist... call on Schweizer.



SCHWEIZER AIRCRAFT CORP.
ELMSA, NEW YORK

December 28, 1953

[illegible]

Survey Table Aircraft Future Const. 15

Guide to High Altitude Basket Design	20
The Case for Constant-Speed Fan	31

WACC en Magyarország: Good Exit... 34

Tularemia Quarantine Airport Traffic Jan... 20

Airline Profits, November Not Record	53
AA Starts Its U.S.-Mexico Airworth	54
U.S., Canada Sign Air Agreement	54
Road Builders	55

New Digest	7
Picture Pages	9
Who's Where	31
Industry Observer	32
Washington Roundup	32
Baker Comments	37
Fiber Center	44
Letters	42, 56
C&E Orders	56
Shortlines	56
Geology Viewpoint	61
Aviation Calendar	61

1—WMA World; 2—call WMA World;
The Radio Network Action Corp. (100-
low Radio World, 100-1000); 10—WMA
World; 11—call WMA World; (100-
low Radio World; 11—call WMA World;
(100-1000) WMA World; 12—WMA
13—Radio World; 14—call WMA World;

These spacecraft action photos of the new USAF and Navy jet fighters show less than North American F-16s: acrobatic team, the Major Knight (below), working on a loop in three diamond formation, first view of a Republic F-105 Thunderbolt (top right) being boosted skyward by four powerful rocket nozzles itself with under the plane's belly, and a Chance Vought F7U-1 Corsair doing night-stomping in his landing with wing darts and V-twin engine nacelles back forward.



Newer Look?

Some top-level leaders on Capitol Hill aren't satisfied that the new Joint Chiefs of Staff have a plan for enough air concentrating on intercept and refueling back on surface forces in their "new look" defense program.

They plan to challenge the Administration with its own aggressive economy. They complain that the Administration, in its efforts to make the armed services "efficient," is overlooking possibilities of sharply cutting defense spending by developing "effective" forces and cutting elsewhere.

Thus the top-level view are supporting two Defense Departments—one to stage a second World War II and the other to wage an unrelenting new type of war.

American Airlines president C. B. Smith expressed the doubts of the dividends in his recent Tulsa speech: "An increasing number of thoughtful men are coming to the belief that there is something wrong with our prevailing approach to strategy, with its emphasis on neither a weapon."

A changed approach, he said, would enable a 1-million personnel cutback, and a \$10-billion-a-year budget reduction. This would leave a 2.5-million total military strength and a \$27-billion annual budget. The Administration's program is understood to mean an eventual reduction to 1.1 million personnel and \$22-billion in \$13-billion budgets.

Symington's Converts

As Fawcett's former Secretary, Sen. Stuart Symington has won new support during the congressional years for his support fight with Defense Secretary Charles Wilson. One outstanding concern Symington raised was that Douglas also supported the Wilson program and was one of the handful of Democrats who voted against proposals to reduce Air Force status this year. Douglas's comment:

"I now publicly confess that I was wrong and that Symington was right. I made the mistake then and I promise that I will not make the same error again."

Current on Symington in contrast Wilson with his insistence that no combat planes would be eliminated from the USAF program and his subsequent cancellation, after Congress adjourned, of 745 combat aircraft.

Machine Tool Program Lays

The program to develop a land mobilization force with a machine tool reserve is dragging. Defense Secretary Charles Wilson, told around the program, hasn't yet so far approved any of the \$176-million approved this year by Congress to launch it.

Air Force's list of requirements were submitted several months ago. But Wilson devoted a review and this won't be completed by Air Materiel Command until the first of the year.

The House Committee recommended a \$900-million cutback the last year to start the program and similar amounts in succeeding years to reduce a machine tool reserve.

Wilson reportedly rejected the program and the \$100 million included in the Treasury release budget was committed by National Security Council.

Senate Military Appropriations Subcommittee, headed by White's home-state senator, Daniel Inouye, balked the first offer. Wilson testified he didn't know "whether

I will need all that money" and that he didn't know "exactly what machinery we will spend it for."

ODM vs. USAF

Top officials of Office of Defense Mobilization don't share Air Force's enthusiasm to increase vastly titanium production. They feel USAF and aircraft manufacturers are asking a vast try to telescope a 50-year project into a few years. They are particularly concerned with Big Gun. Ken Neugebauer's secretary that USAF's titanium requirement may reach 100,000 tons a year in a few years. The cost of this would be \$5 billion a year, or about half USAF's total current budget of \$11 billion, according to ODM officials.

Senators Object

Returning senators indicate that the coming session will be controversial in civil aviation matters.

Sen. Edw. Johnson, top Democrat on the Senate Commerce Committee, will want to sharply increased support program and challenge the Administration's plan to shun it. The program should be of national scope and not a lot of small local projects any more than such dependent, he argues.

Sen. Pat McClellan, top Democrat on the Senate Commerce Appropriations Subcommittee, critic of Civil Aeronautics Board's demands authorizing, normally to transport mail, has demanded hearings. He referred to the action as "an uncontrolled extension of... long-range prescriptive philosophy" and wants legislation spelling out policy on interstate operations.

Budget Bureau Undercuts

Although Commerce's Undersecretary, Robert Marston, and other Republicans, often, suddenly are turning backs, there are not going far enough for Budget Bureau. With its exception, Budget Bureau has been making reductions in department and agency programs, including a \$4-million cut in Commerce's proposal for Civil Aeronautics Administration reform and expansion for fiscal 1975, making a \$82 million. The fiscal 1975 allocation \$141 million.

Civil Defense to USAF?

The recommendation to get Federal Civil Defense Administration in Defense Department doesn't have much steam behind it. It was introduced in the Senate by Sen. Robert Johnson, in which Milvyn Eisenhower, President's State University president, and ODM director Arthur Flemming participated.

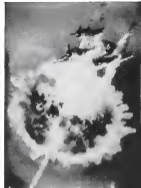
Air Force doesn't want responsibility for administering an overall civil defense program and is strongly opposed.

Guided Missile Tangle

Inter-service differences have delayed completion of an evaluation of the guided missile program being made by a joint panel under the chairmanship of Trevor Gardner, special assistant to the Secretary of the Air Force for Research and Development. Gardner hopes to get a unanimous report to the Office of Secretary of Defense by mid-January.

—Katherine Johnson

AVIATION WEEK



LAUNCH OF A BOMBER: Nike missile (above, left photo) streaks toward B-7; destroys it (photo, right).

U.S. Unveils Defensive Missile System

- Army Nike rocket fires radar beam to target.
- But range is only 18 mi. from site of launching.

First complete U. S. guided missile weapon system is made from official security information was revealed with Army announcement of its superactive Nike anti-aircraft missile.

Indications that the Nike site is one of the first missile weapons systems to achieve a suitable degree of technical reliability stems from the following Army statements:

- Nike missiles have successfully intercepted and destroyed B-7 bombers flying at altitudes up to 30,000 ft, under test conditions at White Sands Proving Ground, N. M.
- Present configuration of the Nike system has been converted to reliable production.
- Nike systems will be installed in the



NIKE BATTERY at White Sands, N. M., with one missile being boosted skyward.



NIKE ON LAUNCHER. Nike boosters

are future as part of the navy as defense of key American cities. First Nike system is scheduled for Ft. George Meade, Md., for defense of Washington, D.C.

The Nike system was developed during eight years of cooperative effort by Army Ordnance Corps, Douglas Aircraft Co., Bell Telephone Laboratories and the Western Electric Co. Douglas is now manufacturing the missile and its components, while Western Electric is building the intercept and control system. Both firms are relying on an extensive network of subcontractors located in 21 states.

► **Delta Fun**—The Nike is a liquid-fueled autonomous rocket that operates at supersonic speeds and can be guided during its flight. It is about 70 ft long, 17 in. in diameter. It has three sets of four delta fins spaced along the missile body for guidance. The forward fins are for steering and the aft fins for stability control.

Function of the third set of fins was not explained by the Army. The Nike body contains an explosive warhead, guidance computer and the rocket propulsion system.

Nike is fired by a remotely controlled launching system and gets its initial speed from a booster rocket that drops off when the missile attains its operational speed.

► **Boss Rules**—The Nike guidance system consists of radar equipment that detects and tracks approaching targets, fires the missiles when targets come within range. Missile is guided by a beam-ride system to intercept the target when its warhead explodes. Warhead is activated so that it can only explode in flight.

The Nike system is one of three

missile systems being developed currently under development by Defense Department. Navy has the Terrier system with Convair using the same missile technology, while USAF is sponsoring the Bomarc system developed by Boeing Aerospace Co.

Army is counting heavily on the Nike system to replace its antirocket guns for the air defense of fixed installations. However, the Nike system is contained in an untransportable vehicle and also can be used with troops on the field.

► **Inter-Area Defense**—Military plans on point out that the Nike system is essentially an inter-territorial defense system because of its relatively limited range. It can reach out only about 15 mi from its launching area, which gives it an extremely short period of attack before high-altitude bombers could drop off even operational bombs. It is extremely doubtful if the Nike could be effective against bombers launching at-ground, rather.

Army has tested Nike successfully against B-17 bombers and also states officially that the missile "can out-race bombers, fighters at trans-port phases."

Current configuration of the Nike missile offers several clues to control problems encountered in guidance of the missile during flight. An additional

set of control fins has been added and the overall length of the missile has been reduced, considerably reducing its forward inertia and ending former requests to control.

The rapid cluster of five booster rockets has been discarded in favor of a large, single booster. The new booster possibly is fueled by alcohol while the sustainer rocket in the missile probably is an acid-methane fuel type, developed by Aerojet-General Corp.

► **Started in 1945**—Nike development project originated in 1945 when the Army Ordnance Corps asked Bell Telephone Laboratories to undertake a study of the problems involved in developing a controlled antirocket rocket.

Five months later, Bell Labs recommended a representative sample article of scientific simple configuration. Douglas Aircraft Co. was brought into the picture as a full partner with Bell for the development phase. Douglas assumed responsibility for developing the missile and launching equipment. Bell concentrated on the guidance system.

Nearly five years were required to solve the technical problems posed by the Nike system. First test flights of the Nike without guidance were made at White Sands in 1950 to improve launcher and booster design. First tests with guidance were made in 1951.



NEW LIFETIME ON LIFE for Tri-Motor (Nike Corps Road C-44 shown) in under study

Stout Plans Tri-Motor Comeback

Details—At least 100 of the famous Ford Tri-Motor all-metal biplanes will be built under new production plan announced here by designer William H. Stout, who says that a study is now underway on a market for the plane.

Stout said a group of California businessmen, whom he did not name, is setting up a company on the West Coast which will handle production. He indicated that the plane would be immediately "profitable" close to the old design, although some changes may be necessary because modern engines are lighter and more powerful than the powerplants used in the original production versions built by Ford during the late 1920s and early 1930s.

► **For Bush Operators**—The new Tri-Motor transports are planned for bush operators since they will be able to

take off from short strips carrying 4,000-lb payloads. Stout says operators will be able to make positively no kind of repairs on the plane without requiring special tools. Price will be approximately \$100,000.

Ford purchased the production rights to the original Tri-Motor July 21, 1925. The first prototype, which had the sub-wing engines mounted in the leading edges of the wing, was rolled out on Nov. 25, 1925, but was destroyed soon afterwards in a hangar fire.

A redesigned Tri-Motor, having the outboard engines mounted below each wing, completed its certification trials July 10, 1926. Two hundred were built.

Harley and are being. Stout estimates Advanced version of the Tri-Motor had a top speed of about 190 mph and cruised at approximately 170.



YENGER DISCUSSES X-1A with Larry Bell (right), holder of supersonic rocket plane.

Mach 2 Problem: Violent Controls

X-1A's 1,650-mph. flight confirms need for substantial research before new 1,000-mph. aircraft are designed.

By Robert Hutz

First exploration of the supersonic speed range above Mach 2 by piloted aircraft confirms the need for a substantial research flight test program in this area before combat aircraft and winged missiles can be successfully designed for operations over 1,000 mph.

Major Charles Yeager, first supersonic pilot who set a new unofficial speed mark of 1,540 mph, on reaching Mach 2.5 in the Bell X-1A (Aviation Week, Dec. 21, p. 7), reported violent control problems as he hit top speed.

NACA's report came shortly after Yeager had piloted Scott Crossfield's subsonic test of the problems of the transonic area as encountered in speed increases (Aviation Week Nov. 30, p. 13). Crossfield was the first pilot to reach Mach 2.

► **Severe Problems**—Yeager declined to give details of his problems in the X-1A, but observed that the joint USAF-NASA high-speed flight research program indicated they were similar to those Yeager experienced in the original X-1 when he went into a high-speed stall about 53,000 ft. and fell more than 10,000 ft. before recovering.

The same kind of the presumed X-1A cockpit was damaged during several maneuvers but there was no major structural damage in the aircraft which was built with double the safety factor of combat fighter aircraft.

► **Saw Shock Waves**—Yeager noted that the cockpit visibility was better in the X-1A than in the original X-1, but once stalled.

"I don't know whether that was all right because I saw a lot of things I'd never seen before when I looked back. I could see the wings heaving and the shock waves on them. It was a rather rough flight. It certainly wasn't as easy as I'd thought it would be. I was quite low with that airplane."

At Edwards, an observer of the flight



TUCKED UNDER 800, Bell X-1A is carried to 50,000 ft. for its launching.



BELL X-1A is similar to earlier X-1 but has stepping canopy for better visibility.

X-1 Family

► **X-1 No. 1** made first supersonic flight of Mach 1.06 Oct. 14, 1947, now in the Smithsonian Institution, Washington, D.C.

► **X-1 No. 2** now being used by National Advisory Committee for Aeronautics at Edwards AFB.

► **X-1A** completed by Bell and designed primarily for research on thermal problems encountered in high-speed flight.

► **X-1C** project cancelled by USAF.

► **X-1D** destroyed in an explosion.

and the violent shocks which hit the plane as it approached its design speed of 1,700 mph were severe enough to alarm the usually calm Yeager.

"His voice on the radio became very excited," he said. "And it's not like Yeager to get excited without great reason."

Yeager also noted that the aircraft "got a little hot" when his instruments even though outside air temperature was -50°.

The X-1A reached flight height with an air launch from 50,000 ft. from a B-29 piloted by Maj. Harold Russell, chief of the bomber flight test section of the USAF Flight Test Center at Edwards AFB. Yeager fired three of his four Reaction Motors Inc. rocket boosters in a climb to 45,000 ft. which he lost as the fourth took.

The climb at full power is an ascent to 70,000 ft. where he leveled off, ready

ing maximum speed just about 70,000 ft. before his rocket fuel was exhausted. ■ **Lighter Wright-Young** said he as perceived "big trouble" in returning from the transonic area to subsonic speed than in an initial penetration because of the higher angle of his aircraft with the fuel burned off and the higher altitude at which he made his return. It was Young's fourth X-1A flight.

Lamarson Bell, chairman of the board of Bell Aircraft Corp., head of the X-1 team, said the X-1A flight test program was gathering valuable data for possible future development and noted that Max Young had flown faster in the X-1A than was asked to do.

The principal difference between the X-1 in which Young became the first man to fly faster than the speed of sound and the X-1A is in the latter's double fuel capacity and the use of turbo-diesel fuel pumps.

The fuel pumps' fuel is driven by steam generated from passing hydrogens passable over exhaust orators that expand in volume at a rate of 1,000 to 1. The rocket fuel is in a closed water combustion with liquid oxygen as the oxidizing agent.

50 Years of Powered Flight

Eisenhower Backs Air Buildup

President tells Wright 50th anniversary celebration that airpower is "absolutely essential" to U. S. defense.

Powered flight's sparkling golden anniversary celebration of Wilbur and Orville Wright's first successful flight at Kitty Hawk, N. C., Dec. 17, 1935, was observed by these dedications:

- President Eisenhower called airpower "absolutely essential" to U. S. defense.
- **Re Gen James H. Doolittle** (Bell's chairman of the national committee for the 50th anniversary) and aviation's first future pilot would be increasing public understanding of the industry, improving airports and maintaining a reliable, long-term program for the development, procurement and operation of military aircraft.
- **Glenn K. Martin** designed 25,000 mph rocket-driven space ships and giant 250-passenger jet airliners.
- **Billy Byrd**, holder of pilot's certificate No. 14, topped the first of Kitty Hawk's 48 flights by reaching that first flight in his hand-made 1912 pusher plane at the exact time and place of the Wrights' historic-making venture on Kitty Hawk Hill.
- **Red Sleds**—Speaking at the annual Red Sled Wright Dinner in Washington, D. C., the President told 1,390 celebrities that despite the need for

power in the atomic age, "no armed forces, of whatever nature, provide real safety over the long run for any nation."

"The power of the impetuous attack," he said, "is never so great something must be done about it."

Following his off-the-cuff remark, the President presented:

- **The Galder Trophy** to Leonard S. Hobbs, vice president/engineering of United Aircraft Corp. for designing the Pratt & Whitney J57 turbine (Aviation Week Dec. 21, p. 17).
- **The Wright Brothers Trophy** to Roy Bell, chief designer for "public voice of aviation value to nation."
- **The Brewer Trophy** to Dr. Leslie Brown of the University of Illinois for achievement in aviation education.
- **Off Key Red Bell-Guy** of Los Angeles, the current year celebration first act, and Doolittle, vice chairman of the Red Sled, Soviet union newspaper, that the American celebration was "propaganda to prove the priority of the Wright brothers in the arena of the airplane."

The Soviet chairman, A. P. Markovskiy Romanov, declared, built an airplane

more than 18 years before the Wrights. "Within the foreseeable future," said the president, "there will be the exciting challenge of space exploration."

- **Call for Strength**—Increasing use of travel by air will create a better understanding among men," Doolittle said. "People will discover that they are much alike after all."
- **Out first success** as we enter the second half-century of powered flight must be to remain strong enough to preserve freedom for only if freedom means an action and all the other virtues of the age of flight continue to foster the promise of a magnificent past."
- **Aviation's Future**—Glenn L. Martin, speaking before the Institute of the Aeronautical Sciences, predicted these developments during the next 50 years of flight in America:

- **Interstellar space ships** with speeds of 25,000 mph.
- **Great 360-passenger jet airliners** around the continents and the oceans in merely a few hours.
- **Atom-powered aircraft**, first as bombers capable of multiple atomic bombardment of the globe, secondly, as emergency transports.
- **Helicopters** capable of taking traffic over distances of 150 mi. or less.
- **Flying boats** with speeds matching that of equivalent landplanes but with greater capacity for cargo, passengers or weapons.
- **Fully automatic airline flight** operations through electronic guidance and control equipment.
- **Reduction** in cost of air travel will bring that of an other form of transportation.

Parley's re-enactment of the first flight climaxed a five-day celebration at Kitty Hawk's old dunes, during which the reconstructed site of the Wrights' flight on Kitty Hawk Hill was dedicated.

Range and long aviation were the Wrights in 1903 were rebuilt and launched and the site taken over by the National Park Service.

■ **DC-7 Record**—Several air maneuvers over the Wright Memorial were held.

A National Airlines DC-7 flew over the site shortly after the new hangar had set a new official international record of 6 hr., 54 min. between the Douglas Aircraft Co. plant at Santa Monica, Calif., and Washington National Airport.

Representing the military were a flight of Air Force North American F-86F Sabers, various Navy, Marine and Army aircraft and the British Electric Gladiators bomber that won this year's England-New Zealand race.

The British bomber flew from Australia, Sydney, to Kitty Hawk in 8 hr. 15 min., to help demonstrate the strides within his field.

The Soviet chairman, A. P. Markovskiy Romanov, declared, built an airplane

F4D Tries for New Airplane Altitude Mark

Edwards AFB, Calif.—Navy test work was attempting to set a new world's airplane altitude record with the Douglas F4D Skyhawk. Mark is 61,660 ft., set by a British Canberra last May.

Two attempts to obtain this record to the U. S. failed because of difficulties with the Skyhawk's Westinghouse J40 powerplant.

Plotting the F4D on an ocean bombing strength was Lt. Col. James Venable, who set a 3-hr. world speed record in the Navy fighter (Aviation Week Oct. 12, p. 10).

Official world's altitude record of 61,235 ft. was established Aug. 21, 1957, in the Douglas Skyrocket by Marine Lt. Col. Marvin Gil. A few inches mark of 72,734 ft. was set in 1955.

The Skyhawk was shooting for the lower than mark under official regulations as an altitude trial. The F4D must top the Canberran record by at least 1% to qualify its record as official.

Continental-Braniff Merger Proposed

Civil Aeronautics Board has proposed a merger of Braniff Airways and Continental Air Lines as an alternative to the voluntary Continental-Panor agreement submitted this month (Aviation Week Dec. 21, p. 99).

Washington observers had known of CAB's long-time desire to bring CAB's old rivalry into an altitude trial. The CAB must top the Canberran record by at least 1% to qualify its record as official.

Y. C. Chen, Merits-The Board is reluctant to say that while not regarding the decision on the pending CAB-Panor case, it would simultaneously investigate the merits of a Braniff-Continental merger.

CAB says it makes the proposal "solely for the purpose of ensuring that should the need in the proceeding debate disposal of the voluntary arrangement between Continental and Panor, the Board will be in a position to determine whether integration of the routes of Continental and Braniff would be consistent with the public interest."

This will delay the Continental-Panor deal. CAB says it CAB doesn't believe CAB merger would be in the public interest, the Board would have to wait a voluntary agreement.

Warding of the CAB reorganization order does not propose a three-way deal between Continental, Panor and Braniff. ■ **Thank For Merger**—CAB's decision may set against the Continental.

Thunderjets Fly Tokyo-Bangkok Nonstop



FOUR F-4S MOVE IN to take on fuel from a pair of Boeing KB-294 Superfortresses high over the South China Sea during course of 7,900 mi. nonstop training flight from Tokyo to Thailand. Jets are using flight refueling pods and drop tanks.



CONTACT with host is made by probe protruding from nose of Thunderjet's port jet tank. These F-4S are using pods mounted in the method of air refueling. They also have refueling pods in wing root cockpit to take Boeing Flying Boma system.



NOSE of modified tank is fitted with probe for use of ground fuel drops. Tank is standard 210-gal. composite.



PROBE, which contacts tanker's boom, gets fuel from raised side of F-4S's jet. These are first photos of installation.

Proctor argues on grounds that it would reverse the previous Board policy of transferring vital civil lines trunk to local service cities.

For instance, CAB told California towns from United Air Lines and gave them to Southern. If the Board can't propose a merger of Southern and Western Air Lines, it would bring about a transfer of United lines to cross border W.A.L.

However, the burden of proof is on CAB to show the valuation. Civil Aeronautics Board wants to be contrary to the public interest. Otherwise it must be approved.

CAB Will Submit

New Balboa Proposal

While there is a few days left to get Civil Aeronautics Board's decision as to which competitive combination of airlines would best serve the New York-South America route.

This is the "Balboa service line," proceeding through service interchange proposals.

Five possible combinations:

• Eastern-Pan American and National-Braniff.



First Photos of New Brantly Copter

How to new Brantly B2 two-place aircraft designed to be used by the public for the first time at recent opening of new nation terminal building, Philadelphia, (Pa.) International Airport, Dec. 12. Top photo shows craft in flight. It is powered by a 155-hp. Economy, but later a 150-hp. engine is to be installed. Cleanup view (left) shows details of main rotor blade mounting. Each blade has two hinges, one at the rotor head and one at the end of the thin-laminate rotor hub. Blade chord is eight inches. Each blade is built up of an extended air streamer type, aluminum ribs and aluminum

covering. Note large bubble in rear of cabin. There is another on right side. Baggage compartment door is shown open behind landing gear on view. Details of B2's tail rotor are revealed in right picture. It is driven by shaft mounted right landing gear and is all-metal construction. Note positive housing. Overall length of the B2 is 27 ft. 11 in., height is 6 ft. 10 in. Main rotor diameter is 23 ft. and tail rotor diameter is 5 ft. 10 in. Gross weight (2500 lbs., net) is given as 1,200 lb. and empty weight 741 lb. Brantly Helicopters Corp. is located in Philadelphia.

• EAL-Braniff and National-PAA. The problem is which way to settle the question, two has stopped CAB and two U. S. presidents.

In real agreement before CAB, Pan American and Eastern noted that the proposed was in the form of a voluntary agreement already signed and ready for Braniff and National and they are willing and that CAB and the White House should not outstrip their position by granting a stronger EAL-PAA route.

Turboprop RBV-1 Begins First Tests

San Diego-Congradated Vultee Air craft's first production RBV-1 Turboprop engine is undergoing extensive testing today and tomorrow is scheduled to begin flight tests with early next month.

Comair launched the big turbo powered Navy transport Dec. 17, christening the Turboprop in the first test as a craft scheduled during the second half century of powered flight.

• Fastest Flying Boat—The flying boat is the first of a fleet of RBV's ordered by the Navy (Aviation Week, May 30, p. 18) and is scheduled to begin from Pacific flight out of Alameda, Calif., next year.

Powered by four Allison T40 turboprops they develop more than 5500 hp each, the flying boat's top speed is estimated at faster than 170 mph and is described by Comair as the world's fastest seaplane transport.

RBV's will be equipped with an air dynamo and high wheels powered from outside.

They also will be fitted with extended wing provisions such as transport troops and wounded personnel.

• Coward's, Latest-Built rate the Turboprop's built in its first design as a modification before the cabin floor level, more water tight exterior and leaving the cabin floor of hulls and other electricals.

Largest water based plane produced by Comair, the RBV has a wingspan of approximately 145 ft., measures 142 ft. 6 in. from stem to stern, and its height is over the tail when on a beaching cradle built 51 ft. 6 in.

Its length and gross rate is 10 about double that of previous designs built in the company.

Roller Top Salaries

Roller Aircraft Corp., Clark, Va., and its president and general manager, Fred H. Baker, \$75,000 for the year ending June 30. J. E. Baker, executive vice president and assistant secretary, received \$53,000. All salaries and director received \$17,500. The firm had net income of \$2,571,295.

RESEARCH REPORT

B.F. Goodrich

FIRST IN RUBBER

New Tubeless Tire for airplanes cuts weight, gives safer landings

TAKE OUT the inner tube and you save more than 100 lbs. weight, simplify assembly. You get a high pressure air plane that is safer, too. B. F. Goodrich engineers were the first to develop and produce one. The blueprint above shows how they did it.

Instead of an inner tube, the B. F. Goodrich airplane Tubeless Tire has a pumped inner liner that's part of the tire itself. There is no tube to add weight. No tube to go flat—to bunch up or shift during landings and take-offs. Instead of one tube, there's only one unit to install. Only one seal to warehouse, too.

The patented inner liner arrives in much longer than conventional tubes. Ridges molded on the outside of the tire bead prevent air loss around the rim. On one-piece wheels, a rubber O-ring seal keeps air from escaping through sections. A special Navy "beaming" test shows the new BFO airplane Tubeless Tire does no air even when compressed to the red.

The B. F. Goodrich airplane Tubeless Tire will soon be in general use on Grumman Cougar jets in Navy service. It will soon be being service on other military planes as well as commercial

aircraft. Its another first is aviation news from B. F. Goodrich, leader in rubber research and engineering.

Other B. F. Goodrich products for aviation include wheels and brakes, De Irvins, bonded rubber, Pressure Sealing, Zippers, inflatable seals, fuel cells, Kinetic accessories. The B. F. Goodrich Company, Akron, Ohio, Akron, Ohio.

B.F. Goodrich

FIRST IN RUBBER



Weather has its brighter side

AND THAT'S WHERE TWA SKYLINERS FLY

Your whole picture of winter travel will change for the better now you've flown TWA. For all thoughts of icy roads and snowbound delays melt away when you travel at TWA's "sun-weather" level. Up here sunshine knows no season, the sun's light year way at night. And while your TWA Skyliner makes time, you spend it in leisurely fashion... enjoying the kind of service that's made TWA the choice of more than two million passengers each year.



When it's too hot to go outside, fly the Sunliner and experience the TWA sun-weather level.

Fly the finest... **FLY TWA**
TWA'S WORLD AIRWAY



Rickenbacker Studies Piasecki Helicopters

Need for a helicopter serving 48-50 passengers and carrying at 200 mph, or better, was expressed by Eastern Air Lines board chairman Eddie Rickenbacker, following a conference with Piasecki Helicopter Corp. officials in Philadelphia, Pa.

The airline executive, accompanied by EAL chief engineer Charles Piasecki and other officials, suggested Piasecki facilities, various copies in production and then set in on a round table discussion with the builder's executives and engineers.

Rickenbacker commented after the conference that "because of the rapid development of the helicopter, it should be possible to produce an acceptable helicopter within the next few days." He said that by 1963, regular service should be flying to various passengers usually on military routes.

There was no indication that Eastern had made any commitment to buy helicopters during the visit. An EAL spokesman said he knew of no plans by Rickenbacker to visit other copier manufacturers in the near future.

Atlas Defends NEA Convair Transaction

Atlas Corp. denies a Civil Aeronautics Board enforcement office charge that the company diverted capital gains from subleased Northeast Airlines, which it controls, to Avco, Inc., an Atlas affiliate.

Atlas' answer to the CAB complaint was that the Northeast sale of five Convair-Learjets at next reduced NEA of the heavy capital burden of necessary equipment. Avco's effort to sell the planes to Northeast before selling them at three to Avco, in Avco's view, Atlas president Floyd Olin says. He adds that Avco's effort has more than \$1 million tied up in the remaining planes.

New RCAF Building Is A-Bomb-Resistant

A new seven-level building, windowless concrete workroom's greater of a mile long has been completed for the Royal Canadian Air Force at Downsview, north of Toronto, in part of the RCAF No. 1 Air Material Base. It is 525 feet wide and 22 feet high, and at one end has a three-story office and access to local administration.

Building facilities include loading ramps adaptable to any truck or barge height and an endless chain conveyor

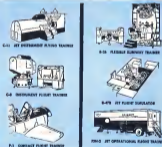
25 years of Synthetic Flight Training for AMERICA'S ARMED FORCES

As the air world expands so do the requirements for the complex electronic equipment that trains more pilots for the air age.

As 1955 draws to a close, LINK looks back 25 years with pride to its contributions, and ahead at the new and exciting developments yet to come.

This year, LINK was privileged to build and deliver a varied group of trainers and simulators to our Armed Forces and to our friends in aviation the world over. In addition to the delivery of these marvels of the air age, LINK in many cases furnishes the personnel to install, operate and maintain LINK equipment.

From the beginning of synthetic flight training, 25 years ago—LINK's record has been one of constant progress and growth... determined to make America's Armed Forces better trained— safer—stronger for the air age yet to come.



C-11 JET ENGINE AND PLANE TRAINER

C-12 FUEL SYSTEM TRAINER

C-13 JET ENGINE TRAINER

C-14 JET ENGINE TRAINER

C-15 JET ENGINE TRAINER

C-16 JET OPERATIONAL FLIGHT TRAINER



LINK invites employment applications from engineers and draftsmen



Retractable AIR INTAKE SCREENS Could make the difference

The safe interception of exasperatingly small bits of debris entering the engine intake could mean the difference between a safe return and no return.

Retractable Air-Intake Screens are a means of protection that allows the mission to be accomplished without the performance loss and icing hazard of fixed screens.

Retractable AIR INTAKE SCREEN

Specifically designed and manufactured for axial flow compressor gas turbines... Hydraulic actuation system contained within the screen housing... Best solution to AM standards and export quality throughout.



SMITH-MORRIS CORPORATION
PRECISION AIRCRAFT COMPONENTS
FERNDALE 20, MICHIGAN

scheduled below floor level viewing at about 5 mph, toward the building.

KCAAF will employ about 3,000 uniformed personnel and civilians at the base when it is fully completed.

New TWA Service Boosts Connie Speed

Trans World Airlines has been able to maintain consistent 9-hr schedules on new nonstop and east transcontinental flights by using 3,500 1,600 hp engines sitting on its 1040E Super Constellation.

Although considerably more horsepower is being pulled from the Wright R3350 engines to keep on schedule, only one failure has occurred. That apparently was due to a broken valve spring and was not attributed to the re-created power settings.

► **Constant Increase-Declimb** beginning nonstop transcontinental service, TWA used 1,600 hp for climb and 1,325 hp for cruise on its Super Constellation. When the new service started, climb power remained the same but cruise power was upped to 1,425 hp to meet scheduled time.

This proved sufficient. So climb power gradually was increased to the current setting of 1,600 hp. Cruise power rose to between 1,500 and 1,600 hp.

► **Fastest Time**—With these settings, net take-off in November, TWA has been able to maintain its 9-hr schedule consistently. For the first part of November, its fastest transcontinental time was 7:22 hr., and its slowest 7:45 hr.

Fuel flow increased from 660 lb/hr./engine at 1,325 hp to 775 lb/hr./engine at 1,600 hp. This means an average flight of 9 hr. consumes 5,688 lb (515 gal.) more fuel.

Flights usually are flown at an cruise time of 14,000 ft.

Delta Pays President \$33,000 Salary

Delta Air Lines, Inc., Atlanta, Ga., paid its president and general manager C. E. Woolman, a \$33,000 salary for the first year ended June 30, 1955, the airline reports to the Securities & Exchange Commission. Delta merged with Chicago & Southern Air Lines Inc. May 1.

In addition, Woolman received \$47.93 in bonus and profit shares plus \$1,911 in pension retirement and also for payments under the airline's group annuity contract and retirement income plan.

Officers received a total \$113,212 in salaries, \$267 in bonuses and profit shares plus \$14,451 in pension retirement and similar payments.



► Big plans for gears and gear assemblies with a customer list that reads like Who's Who in American Industry... CHICAGO 4022 West 43rd Street, Chicago 26
DETROIT 7401 Nichols, Detroit 17

"air-spec" gears and gear assemblies



MAKE AMGEARS YOUR GEAR DEPARTMENT

because its job is vital...

this mount is made
without "cutting corners"

INSPECTION... ROUGH BOREING AND FACING... ROUGH MILLING

G... TURN CONTROL... BAGACH... GRIND... FINISH MILLING...

INSPECTION... ROUGH BOREING... GRINDING... DEBURRING... GRINDING

GUN DRILLING... CUP... BOREING... SPOT FACING

CPS... INSPECTION... PLANER MILL

CHROMIUM PLATING... FINE GRINDING

DROGEN ENRICHMENT... REE... CADMIUM PLATING

FINAL FINISH



These engine mounts provide the only supporting link between engines and airframe, those who buy factor must be beyond question. Also their performance.

Thus takes expert engineering, plus strong alloys, tough heat-treatment, uniformity of materials, precise machining, rigid quality control, inflexible inspection—all of which you'll find back at MB Mounts. No corners cut on quality. These products get the full treatment right from raw materials specifications all the way to inspection by the latest in flow lining methods.

Widespread, unexcelled usage of these MB engine mounts by the aviation industry for the last 15 years proves that they're not only engineered right but also produced right.

Remember—Vibration is MB's specialty. You're invited to draw on the results of this specialization—careful, highly qualified products and technical help.

the **MB** manufacturing company, inc.

1840 State Street, New Haven 17, Conn.

HEADQUARTERS FOR PRODUCTS TO ISOLATE VIBRATION

... TO PROTECT IT ... TO MEASURE IT

Aviation does down the greatest unexploited piece, since 1935. Republic is the lowest with a projected gain of only 9% (However, during 1952 Republic reached a high level of sales).

Another interesting feature is present in the sales volume per dollar of the market price of the individual aircraft engine. On this score, Republic shows up best with \$17.30, and Martin the last mounted with only \$5.70.

► Deliveries—How do current deliveries compare with those of the past year? A comparison shows that Republic was out in front, with expected sales of 195% of its last year. Cessna-Wright has the longest distance to go in order to equal its past best sales—this year's results are projected at only 21% of its high water mark.

Assuming that deliveries will be more based at current rates, bookings indicate material sales for an average of two and a half years for the companies involved. But that is an academic nature, in available schedule revisions in business important modifications in sales projections.

► Working Capital—Wide usage pervades in the market prices placed on working capital solutions. For example, Martin's equity falls at a pace at most? It has been its best reported working capital balance. On the other hand, Cessna-Wright's common stock falls below its working capital. Here, too, an important qualification is present, since the source of working capital accounts and their ultimate disposition must be known before the measure can be recorded any substance.

Working capital is a percentage of sales indicates the degree to which operations are financed. This is an important measure particularly in the light of the separate on progress payments now indicated for the aircraft builders. Cessna-Wright shows up as providing more working capital in relation to its sales than any other company, more 23.5%. Republic contributes the least, 3%.

Annual income yields for 1954 are also indicated. In most cases, Value Line projects dividends at slightly higher levels for 1954 compared with 1953. It can be seen that on the basis of the Value Line estimates, the average yield may range from about 8% to more than 11%. Fairchild, Cessna, Republic and North American, in the order named, are expected to provide a greater measure of income return, according to the service's estimates.

Each of the 11 aircraft companies is reviewed in greater detail by Value Line. An operating outlook, production.

(The operators reviewed are those of Value Line advisory service and not necessarily those of the undesignated or Advisory Week.)

—Sally Altkal

Revere

INSTRUMENTS HAVE A RECORD OF TOP PERFORMANCE IN TOP AIRCRAFT

Revere control instruments have shared the responsibility and achievements of the aircraft industry since 1929 with years of dependable performance under all types of weather conditions. Today Revere is recognized as one of the foremost producers of precision instruments. You'll find them installed in many world famous airplanes.

Extensive research and development facilities coupled with precision production methods contribute immeasurably to Revere's reputation for highest quality control instruments. Contact Revere's field engineering department today. Let qualified engineers assist you with your liquid or electro-mechanical control problems...

FUEL FLOW SWITCH Revere's designed fuel flow switch for use in the auxiliary fuel line of the McCulloch P-43-1 radial, non-reversible engine. This instrument accurately measures fuel flow rate in gallons per hour. Send for Bulletin No. 1400.		
FUEL FLOW TRANSMITTER The Revere fuel flow transmitter is an integral part of the fuel system in many of the top of fuel flow in the T-12-1 jet engine. The fuel transmitter can be used as a pressure gauge, pressure or fuel flow indicator. Send for Bulletin No. 1300.		
LIQUID LEVEL SWITCH Revere's L-4-12 Transducer, Best Liquid Level Switch, is used in fuel tanks. This instrument accurately indicates fuel level in tanks. Send for Bulletin No. 1300.		
FUEL SWITCH Revere's fuel switches have been used in many of the top of fuel tanks in many of the top of fuel tanks. Send for Bulletin No. 1300.		

SEND FOR FREE BULLETINS!

REVERE CORPORATION OF AMERICA
WALLINGFORD 2, CONNECTICUT, U.S.A.
precision instruments for aircraft and industry

Martin Viking Engineer Presents . . .

A Guide to High-Altitude Rocket Design



VIKING 5 on firing stand shows original design plan embodying high dynamic body stress and tapered fins.



VIKING 9 shows design modification to achieve thinner skin, stabilize wingtip for less resistance.

With all the time and money spent on the development of powerplants, propellers and the other complex systems of any rocket, very little has been done to establish even the bare criteria for the structural design. Yet the success of any rocket vehicle can be measured in the ability of the designer to react as much fast and conduct as possible into a little structure as he can get away with.

The importance of structure weight is pointed up with an example: the Martin-NLR Viking high-altitude rocket. It 100 lb could be removed from its structure and added in the form of propellant, the rocket's peak altitude would be increased by about 10 miles.

► **Basic Contribution**—One of the first solutions to the structure of rocket space is to consider the structural design problem in its proper place has been proposed by Richard C. Lee, structure engineer on Gen. L. Martin's Viking Rocket. Lee presented his paper at the eighth annual convention of the American Rocket Society held recently in New York.

Viking has the specific job of high-altitude research between the limits of 100 and 200 miles. Nine rockets have been fired over the last several years on a "hard-and-soft" basis.

Layout is a conical nose and cylindrical fins. A gimbal-mounted Reaction Motors engine (RLM RM 12) running on alcohol and liquid oxygen gives about 20,000 lb. sea-level thrust. Fins, small fins and carbon of the same size and stabilize the rocket in its flight. Over all length is 42 ft., and diameter is 15 in.

Viking research flights were described in *Aviation Week* Jan. 15, 1953, a preliminary study of the vehicle was made in the issue of Nov. 5, 1953, p. 55.

► **Brief Description**—None of the Vikings, including a portion of the structure, can body, carries the instrumentation. The forward nose section features an atmospheric shield for aerodynamic, the aft section is permanently attached, but has four non-structural drag fins. This nose is obviously they are expected to fly at high altitudes for any reaching of instruments.

Tank sections are welded aluminum alloy, and tanks are integral section of separate pressure vessels within a light structure (like the German V-2, for one example).

Two section rockets enter motor, acceleration, pressure and control systems. About half the skin area in this section is in the form of removable drag fins.

Fins are double-winged steel sections, with angle-up, concentric structure. Material is mostly aluminum alloy, with some steel and magnesium.

► **Fracture Loads**—Rocket vehicles of the Viking type would be subject to two classes of loads: flight and ground.

Lee says that it would be desirable, for reasons of efficient structure, to make the flight loads critical for all conditions, but he quickly adds, "Not even the most anxious flight engineer would be anxious to handle and type a rocket designed for flight conditions alone."

This is how the load categories break down on a rocket vehicle.

► **Overall stress and bending moments.** These are obtained in the conventional manner from integration of the aerodynamic load over the length of the rocket body. The resulting load is a summation of aerodynamic and transient loads on the rocket. Transient loads are side loads produced by gust or motor transients at takeoff or burnout, and need be considered by the master of the rocket itself until the vehicle's control system can take over.

► **Local loads for detail design.** These loads, which would include such items as tank pressure and the axial loads on the shell fins drag, thrust and inertia, will generally determine detail design of the shell.

► **Ground loading conditions.** The Viking is mounted by slings, spaced to assume concentrated loads, but the distributed weight between slings will come bearing in the shell, which could be a critical design condition. Support for transportation is also a design problem.

► **Fatigue loads.** Not normally a factor in perfect vehicles, these still are a factor in structure, subjected to extended but periodic, which require particular consideration on this score.

► **Test loads.** Before launching, a rocket may be statically tested at full or partial thrust. The test structure must be strong enough to take restraining forces in addition to the static loads of the support and the dynamic loads of ground winds.

► **Deflections.** Two-shipping of adequate stress levels is making for trouble, Lee says. Static and dynamic deflection in body, fin and components have to be considered.

For example, aerodynamic effects on fins could not yet properly allowed for in design—since the fin flutter may come in pure bending, or more consistently be combined bending and torsion. Reducing the surface in a very thin surface means at high operating speeds is a "new twist," Lee says.

Within the body, stresses of deflection appear. The opening fragments of joints can be fed back into the control system by structural transmission, and cause considerable "noise" in the system. It isn't shown practical to assume stiffness to solve this.

The high-energy rocket motor operators are more equipped to reinforcements, the designer may not have to worry about the operation of these latter devices, but he may be called on to solve the problems imposed by the dynamic environment.

► **Just acceleration, stress and deflection.** of importance when considering a weaving device like a gyro. Aerodynamic mechanisms depends to a great extent on minimizing axial deflection, also.

► **Heat and Cold**—The rocket designer has it a bit tougher than airplane designers in problem of temperature. Bits of the rocket structure can be operating at several thousand degrees while others are down to the minus 200°F of liquid oxygen.

Such an extreme range of temperature produces large deformations, high thermal stresses, and in addition influences material properties.

Reduced temperatures are less critical than elevated ones, but even so there are problems. Construction of long tube lengths is one worry, and processing time must be allowed during the question to reduce thermal stresses.

Phase temperatures in a rocket motor are of the order of 5,000°F, and heat-resistant design for the motor is an obvious requirement. Turbine exhaust gases in the Viking up around 1,200°F—is ducted out of the body, and its pressure near structure is another design consideration.

► **Wing must be either protected or free to move.** as shown in the picture.

But aerodynamic loading of the outer shell is still the toughest design criterion. According to Lee, skin temperature calculations at Mach numbers less



VIKING 6 is slight drag for atmospheric mouth is critical in good gusty case at 100,000 ft. Friction Control. By forward, end tanks through into late coming to get rocket off to stable flight which topped outer tests.



VIKING REMAINS are collected after typical test. Gimbal-mounted motor and mount are visible in right foreground. Rocket is separated on downward leg into nose section and body to measure drag by running pieces to handle.

Engineers Join the Sabre Builders

Invest your future with North American Aviation, The Engineering Department has challenging openings for engineers with a craft experience, for power grade.... for men from other fields with adaptable experience. Twenty-five years of engineering vision and imagination and long-term military projects assure your future. Openings now in:

DESIGN/ANALYSIS • ADVISORY ENGINEERS • STRUCTURES DESIGN/ANALYSIS • ELECTRONICS SPECIALISTS IN AIR WARFARE

JOHN W. JONES

Chief of Staff and Director of Research

North American
Aviation, Inc.

Buffalo 10

Engineering Personnel Office
Los Angeles International Airport
Los Angeles 44, California

Or California 28, 1955

NORTH AMERICAN HAS MANY AIRPLANE
ENGINE AND OTHER COMPANIES IN THE WORLD

than 4.0 appear to be adequate, and properties of materials under shear have been determined by previous experience are being better defined.

There is some help for the Viking in this regard. Its ascending trajectory takes through the atmosphere quickly enough to avoid high heating rates, its downward descent is checked at altitude by slowing due to air oil resistance. Both nose and afterbody thus benefit at reduced speeds, and heating is not a great problem.

In the case of a tactical missile instead of a rocket vehicle the downward leg is the toughest heating problem of all. Accuracy and dispersion demand a short flight time down through the atmosphere, short flight time means high speeds, which means high heat input.

► **Materials Choice**—Most of the Viking is built of aluminum alloys. They are readily available, easy and familiarly worked, and have a high strength/weight ratio. Aerodynamic heating on the Viking is not enough to rule them out for structural materials.

Aluminum is compatible with low-temperature liquid oxygen and the acetylene hydrogen peroxide used to drive the turbo-pump combustion.

But Lea points out the prospective rise for these alternate materials:

- **Alloy steels**, for parts subjected to wear in contact. The higher modulus of elasticity may help reduce deflection under load, although there would not necessarily be any weight improvement.
- **Magnox**, for bulk without weight and with medium strength. One example of this use is in the fins of its structure.
- **Impregnated cloth** blades, for lighter

and more workable fiber than magnesium.

- **Plastics**, for structural and nonstructural parts. Phenolic and acrylic resins with cloth, paper or fibrous glass fibers are used for structural boards, covers and supports. Vinyl and acrylic plastics are used for transparency. Teflon's dielectric properties make it valuable in sensor applications.
- **Heat-resistant materials**, such as titanium, ceramics and other special types should also be considered.

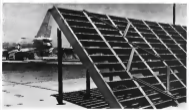
► **Size and Form**—The detail design of the rocket applies the accumulated knowledge and determines, to a great extent, the success of the entire system.

Each of the major components has its own peculiar problems, as well as some related to the entire missile.

The forward sections of the rocket, containing instrumentation and control equipment, have to take overall axial and transverse loads. If the nose is to be sealed for instrumentation, internal pressure will be higher than atmospheric all along the trajectory. Skin and protection will have to withstand air dynamic heating. Instrument nozzles must be evaluated for deflection, and access for instrumentation is another headache.

Trails are designed by combination of bending and axial loads with operating internal pressure. Internal forces may be recovery for bending and transverse loads; but for light loads.

Internal conditions between tank ends—particularly in the presence of liquid oxygen—require careful consideration of deflection and care in welding. Any convoluted structure of gaskets in nose and tail sections must be distributed into the monocoque tank shell.



Jet Blast Fence

Jet deflection was enhanced most from a General Electric J47 turbojet in Boeing B-57E Stratojet on flight line of Boeing's Wichita plant. Deflection not steel fence located about 100 ft behind plane, covered

even two jet blast spread, molting gas damage to other planes or material. Thin picture shows air movement of B-57 for the first time, but gas not yet installed in fence.

Tail section structure must carry thrust loads and must transmit both axial transverse loads and air stabilizing loads into the forward structure. Support structure for landing and support during other both are in this section, as are propellant and control components and the loads from these items.

► **Accessibility**, here is a design merit in the Viking, non-structural items more than four feet long require a 180-degree arc of pivot-point access in a matter of minutes.

► **No Pins, Pliers—Lea** says that has been fact for a while but the systems man. To the accomplishment they few work stabilizing means for the control group, they provide a place to hang the steering apparatus, the avionics people can hang antennas all over them. But for the structural designer, there are much weight and complexity which should and will be eliminated from the design.

Until then, Lea says, the structure must carry high loads in minimum development without further, aerodynamic effects on loading designs.

These still remain the difficult design considerations of handling, testing and firing equipment. Not critical from the standpoint of weight, these requirements and systems are important parts of rocket operation. Light weight, portability, simplicity and convenience are so desirable to operation and safety in the kind of design.

► **Whole To Form**—Hart-Lea says his preliminary with a lot of the difficulties which still beset rocket designers and all the needs for making that design job easy.

He states that development of structural materials and techniques along with consideration of other systems is an essential for progressive rocket design. Then he makes these specific points:

- **Aerodynamic heating** alone Mach 4 needs evaluation and solution by light test measurements. General testing for thermal shock and the associated heat temperature characteristics could save money and weight.
- **High-temperature materials** need more research for their expansion and development.
- **Structural feedback** by a large axial firing mass like a motor or jet vane to the control system will continue to hasten the design.
- **Shock and impact load data** must be obtained systematically.
- **Instrumentation** and together of large diameter, thin-walled vessels give the designer considerable difficulty.

(This article is based on "Structural Design Considerations for a Main Missile Stage for the North American Viking," by Richard L. Lea, Vice President, North American Aviation, Inc., presented at the meeting of the American Nuclear Society, Dec. 5-6, 1955.)

Warner SEQUENCE VALVES

Warner Sequence Valves, designed for any system pressure up to 2000 psi, are adaptable to a wide range of hydraulic applications. These exceptionally priced valves have low leakage and low operating force characteristics.

SOMETHING MORE THAN ACCURACY*

Precision machining ability involving special lapping techniques to hold extremely close tolerances is only a part of the story behind Warner Hydraulic Equipment.

For many years Warner has specialized in the design, development and manufacture of precision hydraulic equipment. As a result of this comprehensive experience Warner is well qualified to assist you in the development of special hydraulic equipment to meet your particular requirements.

* We invite you to utilize Warner's specialized experience in the field of hydraulics by giving our engineers and laboratory technicians an opportunity to work with you in the early stages of design and development.

Send today for your copy of an illustrated folder describing typical examples of Warner Hydraulic Equipment.

Warner DIVISION OF DETROIT HARVESTER CO. OF N. Y. INC.
21300 GROSSHEIM HIGHWAY • P. O. BOX 3548 • DETROIT 3, MICHIGAN
DESIGNERS AND MANUFACTURERS OF HYDRAULIC PUMPS • VALVES • ACTUATORS

Write Branches at:
50 Canterbury Drive
Newark, Connecticut
3023 Forest Park Drive
Fort Worth, Texas

WADC Evaluates Magnesium: Good, But—

Designers and producers must take into account the light metal's sensitivity to "incorrect" handling.

A Wright Air Development Center evaluation of structural magnesium is *cautiously* optimistic. It says this one would reduce the cost of planes and conserve aluminum, which may be a critical material in an emergency.

But, the report points out, most or less automatic manufacturing processes and machines will have to be developed to make the light metal suitable for mass-production use. The present state of the art is believed to restrict use of magnesium in primary aircraft structures to strictly controlled conditions.

Steps already have been taken toward implementation of an all-magnesium aircraft program. No specific details of the program have been disclosed officially, but Aviation Week previously revealed (Sept. 28, p. 15) that a new bomber and a new fighter had been under consideration. In another phase of the work, East Coast Aluminum, Inc., produced an all-magnesium F-80C prototype, which successfully completed successful static tests at Dayton following similar tests with all-aluminum wings. It is expected that the complete flight article will be flying by May or June 1954.

► **WADC's Report**—WADC's action on magnesium is based on the premise that inherent advantages of the material can be made effective only in a feasible aircraft program, backed by adequate experience and supported with adequate equipment. In the past, use of magnesium as a primary structural material in the aircraft industry has been somewhat limited in comparison with lightweight aluminum alloys.

A serial version of WADC's report—"The Suitability of Magnesium for Aircraft Structures"—contains a few minor portions which contain classified information, is presented substantially in this article.

► **Mass Production Aspects**—The scope of WADC's report concerns the technical properties of magnesium alloys as they influence the suitability of the material for large-scale use in primary structures of aircraft.

As far as material other than aircraft is not considered, but WADC's listing is that most other applications such as missiles, ground equipment, etc., largely will be covered by the same considerations. Requirements in

these applications appear to be less exacting generally than those for primary aircraft structures, where both passenger safety and performance must be achieved at the same time.

WADC's study considers only alloys which are important in a wide range of production by an adequately equipped and equipped industry. It discards all problems arising from the introduction of magnesium, since the difficulties of transition period are not considered of primary importance for the evaluation of the possibilities of metal.

Magnesium is evaluated by WADC from three points of view:

- Performance (physical characteristics)
- Structural safety (reliability)
- Processability (predictability and related factors) of aircraft fabricated from magnesium.

Performance

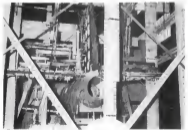
These are the important factors under the category of performance: strength-to-weight ratio, stiffness, and suitability for use of elevated tempera-

tures resulting from high-Mach-number operation.

► **Strength-to-weight ratio** of a composite magnesium structure appears to be equal, essentially, to that of a composite aluminum structure, and thus can be leveraged in favorable applications. This conclusion in the report is based on experience gained with B-35 parts, Sikorsky helicopters, Dewbank F-6 wing panels, and also with the F-80 fuselage and wing built as all-magnesium structures by East Coast Aluminum, Inc., Tillman Munro, N. Y., a subsidiary of Bureau Steel Corp.

► **Stiffness** of a magnesium structure generally will be better than that of a comparable aluminum structure. This is because the specifically lighter and weaker magnesium generally will be used in thicker cross-sections, which means that less buckling under loads will occur.

This favorable stiffness may be a important point in favor of magnesium, the report emphasizes. Efficiently designed magnesium alloy wings will have superior aerodynamic properties permitting increased performance where



ALL-MAGNESIUM F-80C (center) has successfully completed static tests, including overhead conditions, at Wright Air Development Center. Here it is shown under test, with full control wires trussing parts. The structure was designed and built in magnesium by Bureau Steel Corp.'s East Coast Aluminum, Inc., at Tillman Munro, N. Y.

Magnesium Progress

Steps in introduction into the aviation field, magnesium has taken on growing importance. This magazine has followed closely the progress made with the metal, reporting regularly on its effect on design and production. Some of the major articles on aviation with magnesium, reported in *Aviation Week*, are listed here.

- **Mass Magnesium Facilities Sought**, June 28, 1949, p. 42.
- **Magnesium Used in Structural Metal**, July 4, 1949, p. 25.
- **Need Mass Magnesium Sheet Company**, July 15, 1949, p. 15.
- **Magnesium After Corrosion Studies**, Aug. 14, 1950, p. 31.
- **How to Sort Out Magnesium**, May 15, 1951, p. 45.
- **Magnesium Neglected Plane Metal**, Sept. 1, 1951, p. 71.
- **Magnesium Neglected Plane Metal**, Sept. 1, 1951, p. 71.
- **Magnesium Gains Favor as Plane Material**, Dec. 29, 1951, p. 31.
- **Sheet Magnesium Problem Laid**, Jan. 12, 1952, p. 45.
- **WADC in Test All-Magnesium F-80C**, Sept. 28, 1953, p. 25.
- **Magnesium Jet Engine Design**, Nov. 3, 1953, p. 49.

fatter and stiffer overall are the larger criteria. Use of magnesium may make possible the design of thinner wings.

► **Temperature limits** for magnesium presently are about the same as for aluminum, 250 to 500°. But the report reveals that alloys having satisfactory properties at temperatures as high as 500 to 600° have been introduced as castings in certain new engines. Also, sheet and plate alloys for use at such high temperatures are ready for service testing.

It is not yet certain that these developments will be successful, so far as is primary aircraft structures is concerned, the report states. Problems with its reliability and corrosion protecting these high-temperature alloys may prove critical. However, the prospect is that magnesium may find its place about midway between aluminum and titanium as a material for high-speed aircraft, the report says.

On the question of performance, the report concludes that superior designs can be achieved by employing magnesium alloys in applications where their low specific gravity, in conjunction with other physical and mechanical properties, can be used to advantage.

Structural Safety

From the viewpoint of structural safety, magnesium is a material which must be used with great caution. Any deviation from the "correct" design,

Maximum Electronic Performance in any WEATHER



LORD
TEMPROOF MOUNTINGS
ON 618S-J
TRANSCIVER

SENSITIVE electronic equipment for airline transmitting and receiving must give continuously accurate results. For instance, note this "trick" view of the Collins Transceiver, mounted on Lord Temproof Mountings which isolate it from vibration and shock. Lord Temproof Mountings function efficiently throughout operational ranges of temperatures from -50° to +250°F. The Collins Transceiver with speedily tuned elements for maximum flexibility and high power output delivers maximum performance in any weather, completely protected from vibration, shock and excessive equipment motion at resonant frequencies by Lord Temproof Mountings.

May we give you further details on this Lord application or help you solve your specific mounting requirements?

IRVING, CALIFORNIA 220 South Third Street
IRVING, CALIFORNIA 441 Irving Drive
IRVING, CALIFORNIA 441 Irving Drive

IRVING, CALIFORNIA 220 South Third Street
IRVING, CALIFORNIA 441 Irving Drive
IRVING, CALIFORNIA 441 Irving Drive

LORD MANUFACTURING COMPANY • ERIE, PA.



Headquarters for
VIBRATION CONTROL

1

Volscan Unsnarls Airport Traffic Jam



SURVEILLANCE RADAR like the experimental unit, or more conventional rotating radars or cell radar, provide plane location information to Volscan computers.



TRAINING CONTROLLER puts newly arrived aircraft under intensive Volscan control by placing predetermined flight even aircraft's slip on surveillance radar scope.



ANTRAC automatically tracks individual aircraft, so that controlling radar data may track radar. Antenna data is fed into Datas computer.



NEARLY AUTOMATIC traffic control of dozens of aircraft at very high rates of flow is provided by the bank of Volscan Datas using computers, which schedule aircraft arrival

- **USAF** traffic computer lands 120 jets hourly.
- **Unit demonstrated** to civil aviation experts.

By Philip Klaus

Boston—Project Volscan, the Air Force Cambridge Research Center's solution to a pressing military problem (and one which may mean trouble civil aviation) was demonstrated here recently to representatives of USAF operating commands, the Navy, Civil Aeronautics Administration, and Air Navigation Development Board (Aviation Week Dec. 14, p. 7).

• **THE PROBLEM:** How to handle the widely spaced aircraft of jet aircraft, arriving to land with near empty taxi tracks, so that each plane arrives in sequence, close order sequence, without delays at low altitudes when fuel consumption goes up by a factor of three.

• **VOLSCAN SOLUTION:** A nearly automatic traffic control system which determines the optimum time of arrival for each aircraft, continuously calculates the flight path that it must fly to arrive at the prescribed time.

The Volscan computer breaking and rate of descent instructions can be transmitted by voice radio, or automatically by a radio "data link" to a cockpit instrument in the plane. The data link signals can also be supplied into the plane's autopilot so that it continuously keeps the aircraft on the required flight path. (Aviation Week Dec. 14, p. 14).

• **Missing Link**—Volscan, officially designated ANUSCAN-3, is essentially a large analog computer, not a radar or instrument landing system. It forms the link between surveillance (traffic control) radar and the GCA or ILS automatic approach systems which bring aircraft in for final approach and landing.

Volscan can convert a "load of randomly arriving aircraft into an orderly stream" at the final approach entry point at the rate of 120 aircraft per hour for jets, 100 per hour for piston aircraft, regardless of weather conditions, according to Ben F. Gause, Volscan project chief. (Gause received the 1957 Turing Award from the Institute of the Associated Sciences for his work on Volscan.)

• **By Comparison**—Using the same surveillance radar, without Volscan,

human traffic controllers can deliver aircraft at an average rate of only 30-40 hours in good (VFR) weather, many lower in IFR weather, Gause says. The reason is that the traffic control problem is not complex, and although the human mind is superbly efficient.

The figures on Volscan's traffic-handling capabilities are extrapolated, based on the accuracy and precision demonstrated by the experiment in extensive tests at Clinton County AFB, Westfield, Mass., Ohio, conducted in 1952-53. A variety of aircraft types, from C-124 to B-70, participated in the test runs.

• **Practical Reality**—Objective of two weeks of Volscan experimentation is to complete a set of flow data and send aviation representatives that automatic traffic control, an old concept is now a practical reality.

AFMRC hopes to deliver USAF operating commands, CAA, and ANDB is sponsoring development of a few Volscan systems for military-civil aircraft tests in production quantities. AFMRC estimates that a Volscan type system will cost around \$100,000.

CA's Research and Development Center is also working on the automatic traffic control problem, but it is not believed to have advanced to the point of a working main aircraft prototype system.

• **Operating Fundamentals**—Briefly stated, Volscan operates as follows:

When a new aircraft arrives in the control area (50-60 miles from the airport in the present design), it appears on the scope of the surveillance radar (ANUSCAN-3) or civil ASR. Once identified, the nosecone is "tagged" by the series of the human traffic controller.

Volscan then instantly calculates the shortest possible time at which the aircraft could fly directly from its present position to the "entry point" for its final approach. Volscan then sends its "intentions" to see whether this (earliest) time of arrival has previously been assigned to another aircraft. If this transfer is available, it is assigned for the nosecone, if already occupied, Volscan searches for the next available time slot and inserts it for the nosecone.

• **Determining Flight Path**—Knowing the nosecone's present location, and the exact time it must arrive over the entry point, Volscan next computes what flight path the plane must fly, from its present position to bring it in at the prescribed time. The necessary heading and descent instructions are then visually presented to human operators by voice transmission to the plane, or the transmitted automatically by data link.

Volscan monitors the position of aircraft under its control at all times, continuously computing new flight paths

whenever on the basis of aircraft position at each instant.

• **Delay Path Used**—AFMRC has based Volscan design on the principle of one breaking arrival time in one of a randomized or delayed flight path, rather than requiring aircraft to reverse or decrease speed.

Advantage of using this technique is that aircraft heading is only and speed, changed, control of speed is more sluggish, involves substantial aircraft, more work for the pilot.

One disadvantage of the delay-path technique, however, the abundance of its adoption and use for civil aviation, is its radical departure from the familiar air

craft type block approach system which the CAA now uses.

Flying under Volscan control requires no special pilot training, actually this means complicated landing procedures occur a radio fix or on a beam fix, according to Capt. Robert W. Dine, who has used 100 Volscan runs in all kinds of weather. Volscan heading and altitude instructions on (presently) transmittal to the pilot by voice, ready like GCA approach instructions. The pilot need only follow instructions. As a result, pilots like Volscan, Dine says.

• **Spicing Details**—The basic elements in the Volscan system are:
• **Automatic Tracker** (Antenna) isolates

Putting the
"FEEL"
back in the
WHEEL



Now the F44 Thunderbolt "feels" like the pilot is in the seat of the car. The car is the seat of the car. The car is the seat of the car. The car is the seat of the car.

Based on a production line, the F44 Thunderbolt "feels" like the pilot is in the seat of the car. The car is the seat of the car. The car is the seat of the car. The car is the seat of the car.

Grounding design is more available. The car is the seat of the car. The car is the seat of the car. The car is the seat of the car. The car is the seat of the car.

South Gate Aluminum & Magnesium Co.
2221 Twenty Brainerd—South Gate, California—LORAIN 8-1011

South Gate Aluminum & Magnesium Co.

The only nationwide light metal industry in Chicago

2221 Twenty Brainerd—South Gate, California—LORAIN 8-1011

and tracks individual aircraft "blips" from the scanning radar (which has more accuracy under surveillance) and provides a continuous signal representing individual plane position. One feature is required for each airplane under Volcan control, a total of 14 A-10s can handle traffic at the rate of 120 aircraft under A-10C control. Each A-10C has 19 electronic tubes. The A-10C has aircraft position signals to the schedule computer.

• **Schedule computer** calculates shortest possible (direct path) flight time (dt) for a new plane entering Volcan control, scans arrival times previously assigned to other aircraft, then determines shortest possible arrival time for new-comer. This scheduled arrival time (ts) is then fed to the flight path computer.

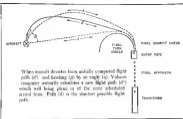
• **Flight path computer** calculates flight path (heading and rate of descent) which plane must fly to arrive at scheduled time and produces signal, processed to computer, to A-10C pilot. One flight path computer is required for each aircraft under Volcan control. 14 are needed for 120/hour capacity. Computers are at the rising edge, contain own heading channel, can alternate control channel. Combination of schedule and flight path computers is called "Dmac."

• **The Human Element**—Although Volcan does away with human aircraft-planning/flight operators, it does not eliminate the human element entirely. In the system demonstrated, humans play the following roles:

• **Traffic controller**. This operator views the surveillance radar scope, spots new aircraft entering the system, identifies them, puts the pilot for his approach and broadcasted altitude, then sets the information (manually) into the Volcan computer. To "assign" a new aircraft into the system, the traffic operator places the barrel of a small pistol-shaped device (mounting a phototube) against the radar scope, over the desired approach blip, then operates the trigger to transmit light identification numerically. By this action, the operator establishes the position of the new aircraft as an A-10C, setting it to tracking the new plane. When the A-10C is tracking the airplane, a small rectangular blip will appear against the airplane blip.

As previously mentioned, two traffic controllers are required to handle 14 A-10s and 120 aircraft/hour. Each is responsible for seven A-10s.

• **Reference**. Volcan-computerized flight path instructions, in the system demonstrated, are presented on small panels (one for each plane) in front of operators, who read these instructions to arrival pilots. One reference can handle three aircraft simultaneously, A-10C's only, because new instructions need be



transmitted only periodically. Desired approach heading is displayed on a directional gyro type of dial pointer arrangement, altitude information is displayed on a voltmeter (calibrated in thousands of feet).

If the plane's speed should fall so low that it cannot make its scheduled time of arrival even by flying the most direct path, the flight path computer automatically flashes an "inverse as speed" light on the airplane's panel, and he radios this instruction to the pilot. The flight path computer detects this condition when it finds that the

ratio of t/t_a is falling below a value of about 0.97.

When the plane is near the final approach entry point, the computer automatically flashes a "lower gear" light on the airplane's panel, and just prior to reaching the entry point, another light flashes and the reference goes the pilot his final heading to the runway. The use of a data link, which is dated for military use in the foreseeable future, will eliminate the reference as truly.

• **Monitor**. He accepts the program of all aircraft under Volcan control on a VFI radar scope, together with a display which shows the scheduled time of arrival for each aircraft, and individual action which shows the t/t_a ratio for each plane. When the monitor sees the t/t_a ratio fall below one, for an extended period, he knows the plane will never make its scheduled arrival time and the monitor must decide what action to take.

If there is an aircraft assigned to the next later time-slot, the monitor can push a button and rechedule the plane to the new time-slot. If every one of the later slots is assigned to other aircraft, the monitor may clear the lagged and bring him out of the approach pattern (by radio instructions) for a new attempt.

Or, if the monitor sees the t/t_a ratio climb above 1.5, he can tell the pilot the plane is rising much too steeply and a course and will have trouble.

When Volcan ground equipment can directly control each airplane's flight path through a data link and the plane's autopilot in his own home experimentally, there is less likelihood of a plane deviating too far from the prescribed flight path. Nevertheless, there will still be need for a monitor and for human judgment.

• **Handling in Emergency**—When a divided plane enters under Volcan control and advises the traffic controller

that it wants an emergency approach, the controller passes an emergency button. When the schedule computer has determined the correct time of arrival for the divided plane, it automatically "bounces" any plane previously assigned to that time slot.

The schedule computer then assigns the "bounced" aircraft to a new arrival time at the end of the period so that only one aircraft approach is disrupted by the emergency.

• **Volcan Flexibility**—Despite the prototype nature of the present system, it incorporates considerable operational flexibility and design adaptability.

For example, a single Volcan installation can feed aircraft alternately into any one of several different airports from several different final approach entry points, providing the airports are within a 20-mile radius and within radio range. A-10C's demonstrated this feature by feeding B-26s and a B-26 into Newwood and Beverly Airports, the Weymouth Naval Air Station, and over Gove's light-house. (A-10s and flight path computer work in a polar coordinate system, making it easy to provide for object entry points.)

Wind velocity and direction corrections can be set into the flight path computer, causing them to modify the computed flight path to compensate for ground winds.

• **Possible Improvements**—Although Cessna believes that Volcan is a big advance over anything now in existence, he acknowledges that the present design could be improved in future models. For example:

• **Altitude scheduling**. At present, the desired rate of descent (determined by aircraft type) is set into Volcan manually by the traffic controller. Based on the time of arrival initially established by the schedule computer, the flight path computer calculates (and indicates to the airplane) what the plane's altitude should be at all times. This design



NEW SMALL DATAC shows how older schedule and flight path computers can be replaced in one with Datascop. One Datascop required for each aircraft under Volcan control. Photo of older Datascop p. 36.

SPRACO



FUEL INJECTION NOZZLES

SPECIALISTS IN DESIGN AND PRODUCTION

SPRAY ENGINEERING COMPANY

ENGINEERS AND MANUFACTURERS
108 CENTRAL STREET - SOMERVILLE 45, MASS.

ENGINEERS

- FLIGHT TEST
- ANALYSIS
- AIRCRAFT STRUCTURES

WILL CONSIDER
RECENT GRADUATES
IN AERONAUTICAL, ELECTRICAL
OR MECHANICAL ENGINEERING

**Salaries & Responsibilities
Commensurate With Exp.**

Opportunity for professional advancement in expanding flight research or production primarily engaged in development of new aircraft. Flight test of aircraft components and flight control equipment. Structural design and stress analysis experience desired.

Particular interest all phases of flight test including preliminary study work, planning of tests, installation of equipment, control equipment, structural design and stress analysis of results.

CENTRAL ISLAND LOCATION
AT INDIANTRAIL AIRFIELD
IN KONGSQUADRA, H. I.

Send Resume to:
Box 218, Beaufort, N. C.
or Phone ROKONKOMA 9-8866
For Interview Appointment
Apply in person flight research dept.



VINYL SLEEVING

Requires precision drawing is widely accepted as the quality standard for the vinyl industry. Contains the high quality vinyl Intertec and Sonoco that eliminates your purchasing headaches and you will undoubtedly why Intertec look the best.

Write for samples and prices



Resinite

RESIN INDUSTRIES, INC.
210 Elm St., Oak Ridge, Tenn. 37829
SPENDING IN VINYL SLEEVING AND VINYL FILM
THE VINYL SLEEVING AND VINYL FILM

TEMCO expansion in high performance field creates

TOP-GRADE OPENINGS for ENGINEERS

TEMCO's rapid growth in the high performance aircraft field has opened challenging career opportunities for qualified ENGINEERS. Write today... giving details of your educational background and experience. Among the top-level positions open now are:



**CAREER
OPPORTUNITIES
OFFERED NOW IN
PROSPEROUS
DALLAS, TEXAS**

POWER PLANT INSTALLATION	THERMODYNAMICISTS
FLUTTER AND VIBRATION EXPERTS	AERODYNAMICISTS
SYSTEM ENGINEERS	SERVOMECHANISM ENGINEERS
STRESS ANALYSIS	ARMAMENT ENGINEERS
WEIGHT CONTROL ENGINEERS	DESIGNERS
ENGINEERING PLANNERS	PRELIMINARY DESIGNERS

Write to:
Mr. E. J. Horton, Jr.,
Engineering
Personnel



Excellent Housing
Available

Box 6177, DALLAS, TEXAS

Fleets of DALLAS • GARLAND • GREENVILLE

3-D Seanning

When the Vulcan project was awarded, its primary objective was to develop a modulation servomechanism and light-focusing video capable of three-dimensional, or "volume seanning"—hence the name Automatic three control was added later in its objective, but its enhancements and means overshadowed the original sales development. At new word, the named Vulcan video system provides only aircraft and range data.

approach leaves something to be desired when actual arrival time differs appreciably from initially scheduled arrival time. In a future design, altitude scheduling would be made to vary with actual flight time, Greene says.

• Three-coordinate optics. At present, Vulcan does not take the altitude of any aircraft under its control. When the aircraft sees two blips approaching each other on his scope, he cannot be sure that they are at their prescribed altitudes, giving a safe separation. For maximum protection under high-density traffic air, Greene would like to see simple altitude information displayed and possibly used in a three-dimensional Vulcan computer, instead of the present two-dimensional computer.

This could be done by adding a light-finder radar to the surveillance unit, but Greene thinks that the use of an airborne altitude sensor, transmitting altitude information via data link, is a better solution.

► Suitable for Civil Use—Seems obvious as well as a basic shortcoming in the present Vulcan system design which only prevent its application to civil aviation. This is the fact that there is no direct communication, or any interaction between individual flight path computers, to make it possible for one computer to learn what the other ones are doing.

Separation between individual aircraft is solely dependent upon the fact that each is scheduled to arrive at the entry point at a slightly different time, presumably over different flight paths, and upon the alertness of the human monitor. There is no omniscient automatic device which continuously scans the airspace in three dimensions to be sure that no two aircraft are in close proximity.

Admittedly this is a difficult and complex task, to perform automatically. Although the probability of collision appears remote, the possibility exists.

For military operations, this risk is much less than that present with current traffic control operations. With increased civil air traffic, and the need of jet subsonic, the gravity of the civil traffic control problem may be

similar to that of the one facing the military. ► Glowing Vulcan's Trail—Whether the present Vulcan is the answer for civil aviation traffic problems is a question for the experts to study and resolve. (See Start, Air Transport Team's next article) expert, was apparently so impressed with the recent Vulcan demonstration that he has scheduled a future visit when there won't be so much "nothing further" around.

If civil authorities are interested, this one available savings with the Air Research and Development Command to have the present Vulcan system set up as an area where it could be used for both military and civil aircraft. Greene thinks the North, Va., area would be a good one.

New Devices Aid Lab, Test Instrumentation

Equipment suitable for use in flight testing and/or laboratory instrumentation has recently been announced, including transducers, recording oscillographs and accessory devices. Details of these new units:

- High-rate pressure pickup, water-cooled for remote exposure to gas temperatures at 5,000°F, is available for jet and rocket engine tests. Manufactured by Control Engineering Corp., 550 Providence Highway, Norwood, Mass.
- Linear position transducer, magnetic reluctance type, will operate as a current indicator at frequencies of 60 to 30,000 cps, with an accuracy of 1% of the operating range, according to manufacturer.



ture. Slide travel range is 1/8 to 1/2 inch. Manufacturer is North American Instrumentation, Inc., 1428 N. Lake Ave., Alhambra, Calif.

• Linear velocity pickup, with high sensitivity, consists of a cylindrical coil and a movable permanent magnet core. One model, the GVA, with a 1-in. stroke, has a sensitivity of 400 mV/in./sec. Manufacturer is Control Components Co., 46 Walnut St., Brookline, Mass.

• High-torque impulse pickup is used to convert mechanical motion to electrical signals without physical contact with the moving object, providing the object is made of a magnetic material. Pickup

weights 2 oz., has output voltage of 10 to 25 v., 500 ohm impedance (at 1,000 cps), and a resonant frequency of 78 to 80,000 cps. Manufacturer is Electro Products Laboratories, Inc., 4501 N. Riverwood Ave., Glendale 90, Ill.

• Second-hand oscillograph, type 5117, weighs 24 lb. It is capable of recording phenomena at frequencies up to 300 cps, according to manufacturer. Device consists of 70-mm wide photo paper, 100 ft. long, housed in a detachable film magazine. 50, kva drive speeds, ranging from 1 to 25 in./sec. are available, by changing gears. Projection has mag lens are recorded every 1/100th second along one edge of the record,

with every track line clearer. A five-digit counter is sideloaded at the right end of each run and photographed to provide record identification. Oscillograph dimensions are 54 x 18 x 14 in. Manufacturer is Consolidated Engineering Corp., 330 N. Kerns Motor Vld., Pasadena 8, Calif.

• Fourteen-channel oscillograph, Model 557 made by Malvern Geophysical Laboratory, has the operational features of oscillograph Model 555 but is designed for greater magnitudes and shock resistance. Unit has built-in timing lars at 0.01 and 0.1 seconds and a beam-integrator type of trace integration. Pulse-width timing system is

UNIVERSAL means a world of KNOWHOW...

COMPLETE ...facilities ...responsibility ...results

FROM DESIGNING TO
FINISHED ASSEMBLY—IT'S
ALL AT UNIVERSAL!

With modern equipment and highly skilled personnel Universal will take charge, then do the entire job: Designing, layout, tooling, forming, machining, finishing, welding, heat treating, construction, assembly, testing, production control, inspection, complete assembling—all parts in quality in volume at Universal!

Let us help develop and guide your complete assembly... on either production or experimental work. Join the list of industrial Universal customers... write, please or wire—today!

UNIVERSAL METAL PRODUCTS, INC.

One of the world's largest manufacturing plants
Serving America's Aircraft Industry

1811 West Orange Street
Glendale 2, California

- Oscillograph accessory, consisting of a power supply and a three-channel demodulator used to serve as a link between sensing elements and an oscillograph in flight test instrumentation bay



09189
FILTER CENTER
 00000

■ **Talbot to Speak**—Secretary of the Air Force Harold G. Talbot is slated to speak Feb. 5 at Washington, N. Y., ceremonies held by Rock Aviation to mark the 25th anniversary of simulated flight. Edwin Lewis, chairman of the board, broke the first simulator 25 years ago in the basement of his father's oil-gas factory. —P

— 18 —

WORLD'S FAVORITE
CHAMPION
SPARK PLUGS

© 2005 BLACKWELL INTERNATIONAL, A JOHN WILEY & SONS, INC., PUBLICATION

49

jet

**fuel controls
precision parts
and assemblies**



built to your specifications by

PIERCE

For 40 years Pierce has specialized in the design and manufacture of engine speed and fuel controls... and servo mechanisms for power controls.

Today, much of America's fleet power-driven equipment... many of her speediest turbines... are equipped with accurate, precision control mechanisms bearing the **PIERCE** Mark of Quality.

Pierce experience and facilities are available to you in the production of component parts for jet aircraft engines... design, fabrication of parts, precision machining and/or assembly, to your specifications.

Success engineering talent, modern, fully-equipped plants, skilled personnel and rigid quality control practices ensure workmanship of the highest order—the greatest economy combined with **PIERCE** quality standards.

Engineering service is available. Your inquiry will entitle you immediate attention of a qualified representative.

THE PIERCE GOVERNOR CO., INC.
1401 WILCOX AVENUE, JEFFERSON, MISSOURI

Ask us to see today... 42 East 42nd Street, New York 17



be paid more—then value is greater, at least temporarily. They will attract new blood and permit the spread leveling and business process to keep the automated engine in its proper place in our economy.

(We are deleting the man's name and address at his request.—Ed.)

Airframe Week Oct. 28, 1965, issued an article on page 21 and 22 entitled "ALA 'No Race' Fact Over Pro."

We, of the San Diego Chapter of the Engineers and Architects Assn. EAA, have known of this Guardian's Agreement for some time. We have, as a matter of fact, published the story in our own newspaper and have at various times told by one of our company's managers (Contract) that the story is a sham and lie. We are pleased that Aviation Week has published correctly the same facts as we did, basing them on the records of the NLRB hearings in Seattle where the story was actually brought out into the open.

Your article, in helping to expose this nefarious scheme, has been of great service to all aircraft engineers. They are the men who have suffered financially as a result of this wage raising agreement.

We congratulate you. You have gained the support of thousands of engineers.

VICTOR STORPE, President
San Diego Chapter, Engineers and Architects Assn.
San Diego, Calif.

Kaiser Metal Products

In your issue of Aug. 30, which gave excellent coverage to the first flight of the B-70A at the Ureco L. Martin plant in Baltimore, your reporter refers to the fact that in the "Kaiser Metal Products Day." This is as most which might logically be made by anyone unacquainted with the Kaiser Metal company.

Kaiser Metal Products, Inc., is an independent, separate corporate entity and is not a division or subsidiary of any other Kaiser organization. It will be appreciated if you'll call this to the attention of your reporter and my editor.

Kenneth J. Wasserman, Manager
Public Relations & Advertising
Kaiser Metal Products, Inc.
Baltimore, Pa.

Bush Operation

I would like to take this opportunity of telling you how pleased I am with the article you wrote on our operations ("Bush Operation" Part 2, p. 10).

It is nice to get publicity of the type facilities type; however, we have on this type of writing, as I am sure other second opinion do, at the industry has undergone the "boom" stage and we think it is now a second boom. It is therefore, very gratifying to think that your magazine considered details of our operations a sufficient interest to publish.

T. F. Fox, Manager
Associated Airways, Ltd.
Edmonton, Alberta, Canada

UP THERE WITH THE BIG NAMES

80 Out of First 98 Convair 340's Use SKYDROL



Nothing exceeds like success. Skydrol, Monsanto's fire resistant hydraulic fluid, passed its first CAA operational test 5 years ago. Today it is recognized as the standard of the industry. Twelve major airlines use it regularly in various amounts; five of these lines also specify it for their Convair 340 fleet.

Skydrol eliminates the danger of fires caused by broken hydraulic lines. It exceeds the nonflammability requirements of AMR 3130.

Skydrol's history is double that of conventional hydraulic fluids. Overlaid rate reductions resulting in savings of 30% or more are not uncommon with Skydrol users.

Skydrol is noncorrosive to aircraft metals... has a total life of 4,000 to 6,000 hours or equivalent 250 hours for delivery merchandise in critical compressor or supercharger transmissions.

Skydrol is resistant... requires no special precautions in handling or storage... is stable at required operating temperatures and pressures.

Skydrol is available for shipment to offices in the United States and abroad. For further information, write: Chemical Division, MONSANTO CHEMICAL COMPANY, P. O. Box 470, St. Louis, Mo.



SEND for this engineering report on Skydrol. Write address above.



REPLYING DIRECTLY TO WHICH DEPT. MARKING

These orders may apply Convair 340's with Skydrol:
Boeing 707... Gulfstream IV...
Boeing 707... Gulfstream IV...
Boeing 707... Gulfstream IV...

Report No. 6-6-65

Mastercraftsmen

translating imagination into an **ENGINEERING MIRACLE**

Here at Turbogear, we support the modern, successful schools, where ideas and imaginations are translated into America's most powerful jet engine components. You can depend on Turbogear precision and skill in the fabrication of combustion chambers, turbine cases, turbine casings, fuel nozzles, burner supports, brackets, all type splittings, tube bending and other essential components.

TURBOG

INDUSTRIES

1965

The second of two articles on profits

What Are PROFITS Used For?

This is the second article on the role of profits in our economy. The first was addressed to the question: "How High are Profits?" The answer was found to be: not high when compared with previous years and the present investment in corporate facilities. This second article is addressed to the equally important question: "What do corporations do with their profits?"

In 1953 corporations will earn about \$30 billion after taxes, if the recent rate of earnings is maintained throughout the year. These profits will be used (1) to expand and improve productive capacity through purchases of new plant and equipment, (2) to finance the operations involved in a growing volume of business and (3) to reward the people who have invested their money in American industry. Of the \$30 billion, the corporations will pay about \$9 billion to their stockholders as dividends. They will use the \$11 billion that remains to purchase new plant and equipment and to increase their working capital.

This year corporations are increasing their plant, equipment and working capital by a total of approximately \$32 billion. Of this amount, about \$26 billion is for new plant and equipment. The remainder is for working capital. As this

article will show in greater detail, about \$21 billion of this will come from depreciation allowances and sales of new securities. The other \$11 billion will come from retained profits.

It is impossible to trace exactly how each dollar of retained profits is spent. This money is mixed with other money that goes into the company treasury in the form of proceeds from loans, sale of securities and depreciation allowances. However, it is a fact that by retaining \$11 billion of their profits this year, corporations have provided \$11 billion toward their total capital requirements, including the money needed for expanded and improved capital equipment.

Profits Mean New Plants

This year American industry is engaged in a very large expansion of plant facilities. This will increase the industrial capacity of the nation by about 7 per cent. Since 1950, our capacity has been increased by about 12.5 per cent. And all of this expansion has been privately financed, even though about one-third of it was certified as necessary for national defense.

The expenditure during 1953 of \$26

Airline Revenues Soar to All-Time Highs

- New peaks forecast by ATA for coming year.
- Scheduled carriers plan to expand fleets 10%.

By Leo Moore

Airline revenues and profits soared to all-time highs this year, and Air Transport Association predicts higher revenues during the coming year.

U. S. airline traffic and revenues will increase about 10% in 1954, ATA predicts. This compares with a 14% increase and 16% traffic volume gain from 1952 to 1953.

Profit margins in late 1953 and all of 1954 will be lower than the 1950-52 highs, ATA believes. Heavy deliveries of new aircraft are causing a drop in load factor (ranked as a percentage of capacity), and, at the same time, higher expense allowances to amortize the new equipment. But airlines counted on this when they added the new planes to one their former airplanes' fleets.

Despite revenue gains, domestic airlines' operating profit rates have dropped slightly in 1953, from 39% in 1952 to 32% in 1953, ATA figures, but the season ended ahead.

U. S. international carriers' profits suffered sharply, however, largely because Civil Aeronautics Board put its new international routes on hold while it studies with profit which most airlines previously expected. As transoceanic break-even already after retroactive profit increases are being permitted (see story in the 1953 closing).

\$200 Million for New Planes—The 1954 forecast for all the world's scheduled airlines (except Communist and China, which remain operational) is a 10% projected increase over 1953. International Air Transport Association estimates that member airlines will spend their country 10% of 1953's GNP to buy over 95% of the world's commercial air traffic.

Airlines probably will spend about \$200 million for 300 new transports scheduled for delivery during 1954 alone, ATA says.

1954-55 Forecasts—Here are other forecasted airline business developments and forecasts:

• Net profits of 10 major U. S. airlines last year gained 30% in the 12

Record Airline Profits in 1953

(10 selected carriers, 12 months ending Sept. 30)

	1952	1953
(000 omitted)		
American		
Revenues	\$136,639	\$204,923
Operating profit	23,097	23,279
Net profit	14,680	18,799
Eastern		
Revenues	\$112,234	140,491
Operating profit	15,624	20,719
Net profit	8,304	9,930
Capital		
Revenues	18,490	40,180
Operating profit	1,496	5,094
Net profit	1,140	4,796
Norfolk		
Revenues	36,818	36,939
Operating profit	4,083	4,997
Net profit	2,332	4,423
United		
Revenues	114,904	166,493
Operating profit	24,667	31,965
Net profit	16,881	20,449
Western		
Revenues	17,227	21,812
Operating profit	2,765	2,747
Net profit	1,120	1,278
Northwest		
Revenues	51,094	60,736
Operating profit	7,115	4,971
Net profit	3,289	2,681
TWA World		
Revenues	313,784	385,075
Operating profit	18,051	16,130
Net profit	8,524	7,144
Four American		
Revenues	105,170	206,470
Operating profit	5,690	17,616
Net profit	6,714	30,616
Flying Tiger		
Revenues	5,337	7,917
Operating profit	1,200	1,222
Net profit	1,378	1,698

(Source: Civilian's Bureau No. 41 reported to Civil Aeronautics Board.)

billion for new plant and equipment—an all-time record—imposes terrific financial responsibilities on our corporations. About one-half of the amount required will come from depreciation allowances. In general, these allowances are supposed to pay for the replacement of worn-out or obsolete equipment. Another \$8 billion will be raised by corporations through new security issues and long-term mortgage loans. All together, depreciation allowances, security issues and long-term loans will provide about \$21 billion. But this is still \$5 billion short of the \$26 billion needed for new plant and equipment this year. Thus, it is retained profits that spell the difference between expansion and standing still, between growth in the productive capacity of the economy and running downhill.

As plant facilities are expanded, corporations also need more working capital. A larger volume of business requires larger inventories, larger accounts receivable and larger amounts of ready cash to meet payrolls and bills for materials. The increase in these items during 1953 is estimated at \$8.5 billion, of which about \$2.5 billion will be supplied by short-term bank loans. The other \$6 billion will come from retained profits. Thus, retained profits provide an essential \$11 billion—\$6 billion for working capital, \$5 billion for new plant and equipment—to meet corporate financial requirements.

Incentive for Investment

The role of the profits that are paid to stockholders as dividends or to employees under profit-sharing plans is even more important than the role played by retained profits in providing plant, equip-

ment and working capital. Dividend payments provide the main incentive for investment in the stocks of corporations. They are the reward for risks taken by investors. Dividends paid by corporations whose common stocks are listed on the New York Stock Exchange provide an average return of about 6.5% at present prices, and dividends on preferred stocks average about 4.5% return. Dividends are distributed among 6.5 million stockholders. Also, it is estimated that 3 million employees now are covered by profit-sharing plans. These plans increase the incentives of both production workers and managers to work harder and more efficiently.

Thus, more than 9 million Americans have a direct financial stake in corporate profits through ownership of stock or participation in profit-sharing plans. But all Americans share indirectly in the rewards of a successful business year. Investment of a major part of 1953 profits in new plants and equipment means more employment opportunities and better working conditions for labor. For the nation, it means new industrial capacity that is essential both for national defense and to produce more and better goods for a rising standard of living.

Corporate profits after taxes represent about 6% of the nation's total income. But the job they do to stimulate investment and to finance industrial expansion and improvement is more far-reaching and more essential to the prosperity and well-being of the American people than would be suggested by that small figure.

McGraw-Hill Publishing Company, Inc.

months ending Sept. 30—1953 vs. 1952.

• Revenues reported by the same 10 carriers gained 17% in the same period.

• Transline passenger revenues in 1953 climbed \$100 million or 15% from a year ago. A slightly lower gain is anticipated for 1954.

• Transline mail revenue gained \$200,000 or 2% in 1953. The growing Post Office Department requirement of shipping postpaid first-class mail, but because more rates by air instead of by rail, these rates are competitive in expected to boost mail revenues next year, despite decline of military mail.

• Transline express revenue increased about \$1 million or 11% and checked airlines increasing.

• Transline freight revenues in 1953 increased \$5 million or 12%.

• Total truck operating revenues climbed \$177 million or 14% to an estimated \$875 million.

• Truck operating expenses gained \$139 million or 36% to \$393 million in 1953.

• Truck operating profits now have declined a slight 3%. ATA predicts, however, that year's 1955 profits to an estimated 302 million in calendar 1955. Net profits are not predicted, because of the complexities of several accounting adjustments.

• World traffic forecast for 1954 carriers is a 10% gain in 1954. In 1953, they carried more than 50 million passengers, 25 billion passengers-rides, while cargo volume was 685 million ton-miles and averaged 190 million ton-miles. AT will continue expansion in

Domestic Trunk Airlines Revenues & Profits

October 1952 (\$)

	1952	1951
Passenger revenues	\$871,157,815	\$777,451,566
Mail revenues	\$5,900,263	\$6,571,006
Express revenues	\$5,641,660	\$5,685,249
Freight revenues	\$7,126,528	\$5,677,777
Total operating revenues	\$789,814,145	\$755,385,515
Total operating expenses	\$727,585,669	\$703,266,137
Operating profit	\$62,228,476	\$52,119,378

Domestic Trunk Traffic

	1952	1951	% change
Revenue passengers	22,758,174	20,668,791	+10.1
Revenue passenger miles	12,132,713,080	10,717,145,080	+12.5
Mail ton miles	60,296,190	52,258,521	+15.4
Express ton miles	60,775,540	49,840,548	+22.0
Freight ton miles	177,235,111	131,811,850	+34.5
Total revenue ton miles*	3,631,458,031	3,046,186,974	+19.5

*Total ton miles include intercontinental charter operations but exclude intracountry charter flights.

Source: Air Transport Statistics and Forecast for 1953, Commercial Division of U.S. Bureau of Economic Analysis. Figures are based on preliminary data for 1952 and 1951. Figures for 1952 are preliminary. Figures for 1951 are final. Figures in parentheses are in millions of tons.

1954, according to IATA director general Sir Wilton Edmond.

• **IATA revenue**—The revenue increase will not quite match the predicted 10% gain in 1954.

• **Passenger traffic** and rates will help offset the volume of passengers and cargo next year, but these same lower fares combined with advances in equipment and decreased unit operation for carrying aircraft will keep the balance of airline finances generally precarious. Sir Wilton explains: "The international aviation market confident that the world economy will continue to improve, and the present high level of activity will be maintained."

• **Non-traffic**—ATA says, "The last half of 1953 gave evidence that rates of traffic increase are decreasing and production the prospect that in 1954 the industry income will be much lower than recently enjoyed."

The "trunklines" had sound evidence to support their view that competition, but a short while back, it was common to assume the current program against the Pullman traffic of the railroads. ATA says: "Five years ago when Pullman was sharply more than the traffic in 1953, it was approximately 70% greater than the Pullman, and approximately one-half of the total rail traffic coach and Pullman, but excluding rail commutation," ATA adds.

"Airline coach traffic also continued to grow rapidly," says ATA, pointing out that in 1952 coach air was about 70% of the total. During the last year it climbed to 93% of total passenger traffic.

American Starts First U.S.-Mexico Aircoach

(McGraw-Hill World News)

Mexico City—American Airlines today officially began its monthly aircoach service to Mexico.

Observers here expect Pan American World Airways to begin flying tourist service from Houston to Mexico City to meet A's monthly challenge. But there is no official confirmation here.

• **American Service**—American this month became the first carrier to start coach service to Mexico, flying 30 passengers DC-6s from New York and Chicago to Mexico City.

Fares on the new service moderate first-class rates by as much as 40%, a sharp discount reflects not only an entirely new air travel market in Mexico and Central America but also the fact that the new service is expected to be as much as 50% of the total coach service.

American flies from New York to Mexico City at 99¢ a passenger with \$345.00 on round-trip flights. On the Chicago-Mexico City flight the fare is \$36—only 38¢ less than the first-class charge of \$114.

• **Passenger Backlog**—American says that there is a potential traffic backlog. Civil Aeronautics Board has limited flights from 7,600-800 high-Mexico City flights to 65 per week.

The carrier faces this restriction on return flights to the U.S. as well as in its current battle with American Airlines. Competing Lines—Other competitors

to A's annually challenge could come from Trans-Canada Air Lines, which has won its fight to fly from Montreal and Toronto to Mexico City via Tijuana, Fla. Other domestic air carriers flying into that city include Pacific Airlines, Air France and KLM Royal Dutch Airlines.

Philippine Airlines are scheduled to begin service this fall from San Francisco to Mexico City, but PAA affiliate Compañia Mexicana de Aviación won an injunction from a Mexican court restraining PAA from operating the route previously approved by government authorities. The injunction was granted on grounds that Philippine's permit was not ratified by the Mexican senate and thus was not valid.

U.S., Canada Sign New Air Agreement

Toronto—Trans-Canada Air Lines will begin flights from Montreal and Toronto to Mexico City via Tijuana, Fla., Jan. 2 under a new agreement reached by U.S. and Canadian air transport officials.

The agreement increases permits government-owned TCA to land at Tijuana en route to Mexico City, a right that was denied by Civil Aeronautics Board shortly before the carrier was scheduled to inaugurate the service Nov. 1 (Aviation Week Nov. 23 p. 18).

After the U.S. granted Trans-Canada a license to operate one-plane service on the new route, the Canadian Air Transport Board called off lawyers ordered against Pan American World Airways and Colonial Airlines.

The two U.S. carriers were scheduled to show case Jan. 14 who Canada should not control routes on Pacific flights made on through routes (Aviation Week Nov. 15 p. 13).

Meanwhile, Transair Montreal Local Chicago cut U.S. and Canadian air transport officials will issue route wheels and license new routes.

One under consideration direct flights from Toronto to Washington.

BOAC Reports High Revenues for DC-4M

Withdrewal of all Handley Page Hermes aircraft is "the most noteworthy single step" British Overseas Airways Corp. has taken in the past year, BOAC says in its 1952-53 financial reports. Sir Miles Forster, replacement of the Hermes on the East African route by Douglas DC-4M. Agreements will increase BOAC's revenue by about \$1,400,000.

American Airlines now makes the East Africa route a paying proposition after the airline opened it at a loss many years

Roof Heliport

- New design uses cable towers, landing turntables.
- Capacity is estimated at 40 copters hourly.

Helicopter manufacturers, airlines and city management now studying heliport design requirements for the 1960s now consider an old idea with a new twist.

A patent applied for by S. Tobin Chachet, Jr., industrial interior designer in Washington, D.C., proposes an automatic cable-tow system to cause heliports from a landing turntable to one set of small cable-tow landing platforms, then onto the heliport area. The proposed system is in effect a combination of San Francisco cable-cars and Navy aircraft carrier techniques.

Chachet's proposal—Chachet's idea stems from his belief that this may help meet current problems that will be associated with handling of frequent landings and takeoffs of big (40-50 passenger) copters in small downtown heliports.

• **Noise and wind**—existing passenger and ground crews when the heliports are under their own power.

• **Ground risk of accident** during two operations in the crowded and confused area of city heliports.

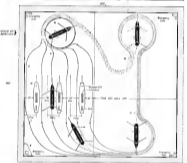
• **Rapid construction** from two operations.

• **Rapid handling**—Chachet claims that his system probably can meet the Air Transport Association's tentative requirement of about 90 or more takeoffs and landings per hour at some city heliports.

• **How it Works**—Chachet proposes that the helicopter land on an air taxi onto a turntable, then lift off or slide its engine. Covered operators turn the copter to put it on its way to the cable platform belonging to the intended landing platform.

Ground crew (which could be the cable operator) pushes the cable to the wing, and the copter is moved to the landing platform.

When the copter is loaded, the cable is retracted and moves the copter to takeoff point. The circular course of the cable around the heliport area permits the pilot a uniform of flight before he releases the cable and takes off under the copter's own power. Chachet's preliminary air drawing (see diagram) contemplates three separate landing platforms, giving a theoretical peak capacity of eight copters at once on the automatic cable system of the heliport—one landing, six on the loading and one taking off.



- **Ground or Roofing**—Chachet's original patent application calls for a positive landing location, and his cable-tow system indicates that a typical big office building is big enough to accommodate a three-platform system of the type he proposes.
- **Chachet's proposal** is one long-range attempt to force the heliport cost and passenger acceptance requirements for such a heliport.
- **Other Studies**—Other groups and individuals are attempting to forecast heliport requirements, which also have a direct relationship to future helicopter

designs and recovery safety regulations. The industrial engineering design firm of Burns and Roe in New York recently placed two men on a full-time study of the outlook for heliport requirements from 1958 on. Air Transport Association, New York Port Authority and other groups are engaged in similar and allied studies.

A central clearing house for heliport plans in the Aircraft Industries Association's research and its heliport cost center, to which Chachet plans to present a paper next month, will have ideas.



HAVE YOU EVER THOUGHT OF A GENERAL MOTORS' CAREER?



ENGINEERS DESIGNERS
 Electronic Electro-Mechanical
 Servo

RIGHT now we have technically effective and enthusiastic men of the creative spirit for high caliber engineering jobs of the advanced type. We are looking for men who are interested in the work of the future and who are ready to take the first step.

AERODYNAMIC INSTRUMENTATION SERVO-MECHANISMS COMPUTERS AVIONICS

There will be personal positive progress in our engineering work of the future. We are looking for men who are interested in the work of the future and who are ready to take the first step. We are looking for men who are interested in the work of the future and who are ready to take the first step.

INTERVIEW OR EMPLOYMENT

FIELD ENGINEERS

Assignment—you will assist in the installation, operation, and maintenance of the equipment of the field. You will be responsible for the proper operation of the equipment and for the maintenance of the equipment.

Your Background—your educational background should be in the field of the field. You should have a degree in the field of the field. You should have a degree in the field of the field.

Training—you should have a degree in the field of the field. You should have a degree in the field of the field. You should have a degree in the field of the field.

Help Build Tomorrow's World TODAY!



GOODYEAR AIRCRAFT CORPORATION, pioneer and leader in lighter-than-air craft, offers you a new employment opportunity with a well-established and fast-growing company where "careers are planned."

DESIGN AND DEVELOPMENT engineering opportunities are available for capable and imaginative men and women in the field of airships, aircraft and aircraft components.

RESEARCH AND DEVELOPMENT projects — missiles, electric and electronics systems, servomechanisms, new special devices, fiber resin laminates — all present an urgent need for engineers with fresh talent, aptitude and ambition.

POSITIONS ARE OPEN at several levels in various fields with salaries based on education, ability and experience.

Physicists	Civil engineers
Mechanical engineers	Electrical engineers
Aeronautical engineers	Technical editors
Welding engineers	Technical illustrators

AKRON, THE HOME OF GOODYEAR AIRCRAFT, is located in the lake region of northeastern Ohio. Cosmopolitan living, year-round sports and recreation, cultural and educational advantages make this thriving city an ideal spot for a pleasant home.

YES, BUILD YOUR FUTURE — TODAY! Write, giving your qualifications, or requesting an application form.

C. G. Jones, Salary Personnel Department



GOODYEAR AIRCRAFT CORPORATION, 1210 MASSILLON RD., AKRON 15, OHIO

AC Spark Plug Division • GENERAL MOTORS CORPORATION
 1200 E. KOSKOWSKI BL. NEWARK 2, N.J.

STRESS ANALYSTS

with actual aircraft stress experiences

Also AIRCRAFT ENGINEERS AND DESIGNERS

Here's an opportunity to work in one of the most interesting and latest-growing segments of the aviation field—

HELICOPTERS

Sikorsky Aircraft, foremost designer, developer, and manufacturer of helicopters, is terminating its production of the latest type, combat-proven helicopters and is expanding its research and development program.

Here's your chance to work with the top men in your profession—men who made the first practical helicopter.

You'll Find at Sikorsky Aircraft:

- a company with large and important orders
- an engineering staff of exceptionally high caliber
- uninterrupted research and testing facilities
- a project for and interest in new ideas

You'll Enjoy These Advantages:

- excellent salary
- cost-of-living adjustments
- good chance for advancement
- many incentive benefits, including a retirement savings plan

Moving Expense Allowance

Send resume to **E. H. TUTTLE**

SIKORSKY AIRCRAFT

Division of United Aircraft Corporation
 Bridgeport 1, Conn.

ASSISTANT SUPERINTENDENT

We are looking for a man with a broad machine shop background who has spent the last several years in a responsible position in airplane production. Some engineering training or experience is desirable but not essential.

This position is with an established aircraft company with an excellent reputation in the industry for design and building quality airplanes and components.

If you feel you can qualify, send your resume including your salary requirements to:

PERSONNEL DIVISION
 100 W. Madison Ave. Chicago 26, IL



ALL AVIATION INSTRUMENTS

EMERGENCY REPLACEMENT • OVERHAUL • SALE

Instrument Associates offers you the services of their CAA approved laboratories for fast overhaul, modifications and sales of aviation instruments. Whether one instrument or thousands, our professional fee facilities for the overhaul of instruments results in a savings at both time and usage. If you're interested with our services, please call or present our advertisement and we'll serve you.

Authorized Sales and Service for
ECLIPSE — PIONEER • KOLLSMAN • U 3 GAUGE
L. N. SCHWIMM ENG. CO. • EXIDE AIRCRAFT BATTERIES

CONTRACTORS TO D. S. & P. — U. S. N. — DOMINION OF CANADA

C.A.A. APPROVED REPAIR STATION 20386

INSTRUMENTS CLASS 1, 2, 3, 4

AND LIMITED ACCESSORIES

INSTRUMENT ASSOCIATES

234 GREAT WEST ST. SUITE 203
Toronto, Ont. M5T 1A7

Write for Catalog M7000 or call 416-593-1246

FOR SALE

Douglas—DC-3, DC-4, DC-6
Cessna—240
Lockheed—Constellation
Boeing—D-18S, C-18S
Lockheed—Executive Interior or
For Conversion

Phone—Windsor
WESTAIR, INC.
WINDY PLAINS NEW YORK

GRUMMAN MALLARD, G-73

FOR SALE

Recently assembled, fully equipped,
first time, 1960 model.

SKYMOTIVE, INC.
P. O. 448 Peck Ridge, Ill.
Tulsa 2190

FOR SALE

LOCKHEED LUNAR—Model 16-56
First Lockheed Lunar—Model 16-56
First Lockheed Lunar—Model 16-56
First Lockheed Lunar—Model 16-56
First Lockheed Lunar—Model 16-56

ATLANTIC AVIATION CORPORATION
10000 ROUTE 1, Suite 100, Richmond, Va. 22601

FOR SALE

PORTABLE STEEL AIRFIELD
2000 TONS of
Strong steel landing mats
New to old, in one piece
Set out large shipping facilities

ALTER CO. Champaign 3, Iowa

Remount-Walker, Inc.
London 1001 St. Louis Ave.
Remount-Walker, Inc.

MANNING EQUIPMENT CO.
1 EAST 48th Street, New York 17, N. Y.
Phone: (212) 687-1070

FOR SALE
DOUGLAS DC-3C
Remount-Walker, Inc.
Remount-Walker, Inc.

ATLANTIC AVIATION CORPORATION
10000 ROUTE 1, Suite 100, Richmond, Va. 22601

NEW BG SPARK PLUGS
Recommended for 81000 & 81000
1960 Available at 75¢ each
No Lot Purchase

AIR TRANSPORT SERVICE
Remount-Walker, Inc.

FOR SALE

2 DOUGLAS C-47A's
One for sale, one for sale
Remount-Walker, Inc.

ATLANTIC AVIATION CORPORATION
10000 ROUTE 1, Suite 100, Richmond, Va. 22601

FOR DC-3 LEASE
DC-3 available, with crew, for long term
lease to Government. Very desirable.
Amesbury, Mass. Full equipment

ATLANTIC AVIATION CORPORATION
10000 ROUTE 1, Suite 100, Richmond, Va. 22601

UNUSUAL OPPORTUNITIES
can be found each week
in the
SEARCHLIGHT SECTION

WORLD'S LARGEST STOCK!

All parts listed—plus many more—are always stocked in our huge stock of unused aircraft parts, accessories, AN and NAS hardware. Let us screen your inquiries.

AIRCRAFT ACCESSORIES

Manufacturer	Mfg. Part No.	Ques.
Boeing	747-1	1
Boeing	747-2	1
Boeing	747-3	1
Boeing	747-4	1
Boeing	747-5	1
Boeing	747-6	1
Boeing	747-7	1
Boeing	747-8	1
Boeing	747-9	1
Boeing	747-10	1
Boeing	747-11	1
Boeing	747-12	1
Boeing	747-13	1
Boeing	747-14	1
Boeing	747-15	1
Boeing	747-16	1
Boeing	747-17	1
Boeing	747-18	1
Boeing	747-19	1
Boeing	747-20	1
Boeing	747-21	1
Boeing	747-22	1
Boeing	747-23	1
Boeing	747-24	1
Boeing	747-25	1
Boeing	747-26	1
Boeing	747-27	1
Boeing	747-28	1
Boeing	747-29	1
Boeing	747-30	1
Boeing	747-31	1
Boeing	747-32	1
Boeing	747-33	1
Boeing	747-34	1
Boeing	747-35	1
Boeing	747-36	1
Boeing	747-37	1
Boeing	747-38	1
Boeing	747-39	1
Boeing	747-40	1
Boeing	747-41	1
Boeing	747-42	1
Boeing	747-43	1
Boeing	747-44	1
Boeing	747-45	1
Boeing	747-46	1
Boeing	747-47	1
Boeing	747-48	1
Boeing	747-49	1
Boeing	747-50	1
Boeing	747-51	1
Boeing	747-52	1
Boeing	747-53	1
Boeing	747-54	1
Boeing	747-55	1
Boeing	747-56	1
Boeing	747-57	1
Boeing	747-58	1
Boeing	747-59	1
Boeing	747-60	1
Boeing	747-61	1
Boeing	747-62	1
Boeing	747-63	1
Boeing	747-64	1
Boeing	747-65	1
Boeing	747-66	1
Boeing	747-67	1
Boeing	747-68	1
Boeing	747-69	1
Boeing	747-70	1
Boeing	747-71	1
Boeing	747-72	1
Boeing	747-73	1
Boeing	747-74	1
Boeing	747-75	1
Boeing	747-76	1
Boeing	747-77	1
Boeing	747-78	1
Boeing	747-79	1
Boeing	747-80	1
Boeing	747-81	1
Boeing	747-82	1
Boeing	747-83	1
Boeing	747-84	1
Boeing	747-85	1
Boeing	747-86	1
Boeing	747-87	1
Boeing	747-88	1
Boeing	747-89	1
Boeing	747-90	1
Boeing	747-91	1
Boeing	747-92	1
Boeing	747-93	1
Boeing	747-94	1
Boeing	747-95	1
Boeing	747-96	1
Boeing	747-97	1
Boeing	747-98	1
Boeing	747-99	1
Boeing	747-100	1

AIRCRAFT ENGINES & PARTS (Cont.)

Manufacturer	Mfg. Part No.	Ques.
Boeing	747-1	1
Boeing	747-2	1
Boeing	747-3	1
Boeing	747-4	1
Boeing	747-5	1
Boeing	747-6	1
Boeing	747-7	1
Boeing	747-8	1
Boeing	747-9	1
Boeing	747-10	1
Boeing	747-11	1
Boeing	747-12	1
Boeing	747-13	1
Boeing	747-14	1
Boeing	747-15	1
Boeing	747-16	1
Boeing	747-17	1
Boeing	747-18	1
Boeing	747-19	1
Boeing	747-20	1
Boeing	747-21	1
Boeing	747-22	1
Boeing	747-23	1
Boeing	747-24	1
Boeing	747-25	1
Boeing	747-26	1
Boeing	747-27	1
Boeing	747-28	1
Boeing	747-29	1
Boeing	747-30	1
Boeing	747-31	1
Boeing	747-32	1
Boeing	747-33	1
Boeing	747-34	1
Boeing	747-35	1
Boeing	747-36	1
Boeing	747-37	1
Boeing	747-38	1
Boeing	747-39	1
Boeing	747-40	1
Boeing	747-41	1
Boeing	747-42	1
Boeing	747-43	1
Boeing	747-44	1
Boeing	747-45	1
Boeing	747-46	1
Boeing	747-47	1
Boeing	747-48	1
Boeing	747-49	1
Boeing	747-50	1
Boeing	747-51	1
Boeing	747-52	1
Boeing	747-53	1
Boeing	747-54	1
Boeing	747-55	1
Boeing	747-56	1
Boeing	747-57	1
Boeing	747-58	1
Boeing	747-59	1
Boeing	747-60	1
Boeing	747-61	1
Boeing	747-62	1
Boeing	747-63	1
Boeing	747-64	1
Boeing	747-65	1
Boeing	747-66	1
Boeing	747-67	1
Boeing	747-68	1
Boeing	747-69	1
Boeing	747-70	1
Boeing	747-71	1
Boeing	747-72	1
Boeing	747-73	1
Boeing	747-74	1
Boeing	747-75	1
Boeing	747-76	1
Boeing	747-77	1
Boeing	747-78	1
Boeing	747-79	1
Boeing	747-80	1
Boeing	747-81	1
Boeing	747-82	1
Boeing	747-83	1
Boeing	747-84	1
Boeing	747-85	1
Boeing	747-86	1
Boeing	747-87	1
Boeing	747-88	1
Boeing	747-89	1
Boeing	747-90	1
Boeing	747-91	1
Boeing	747-92	1
Boeing	747-93	1
Boeing	747-94	1
Boeing	747-95	1
Boeing	747-96	1
Boeing	747-97	1
Boeing	747-98	1
Boeing	747-99	1
Boeing	747-100	1

GAUGES

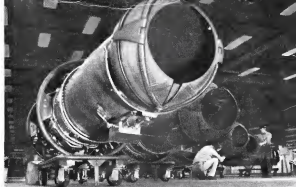
Manufacturer	Mfg. Part No.	Ques.
Boeing	747-1	1
Boeing	747-2	1
Boeing	747-3	1
Boeing	747-4	1
Boeing	747-5	1
Boeing	747-6	1
Boeing	747-7	1
Boeing	747-8	1
Boeing	747-9	1
Boeing	747-10	1
Boeing	747-11	1
Boeing	747-12	1
Boeing	747-13	1
Boeing	747-14	1
Boeing	747-15	1
Boeing	747-16	1
Boeing	747-17	1
Boeing	747-18	1
Boeing	747-19	1
Boeing	747-20	1
Boeing	747-21	1
Boeing	747-22	1
Boeing	747-23	1
Boeing	747-24	1
Boeing	747-25	1
Boeing	747-26	1
Boeing	747-27	1
Boeing	747-28	1
Boeing	747-29	1
Boeing	747-30	1
Boeing	747-31	1
Boeing	747-32	1
Boeing	747-33	1
Boeing	747-34	1
Boeing	747-35	1
Boeing	747-36	1
Boeing	747-37	1
Boeing	747-38	1
Boeing	747-39	1
Boeing	747-40	1
Boeing	747-41	1
Boeing	747-42	1
Boeing	747-43	1
Boeing	747-44	1
Boeing	747-45	1
Boeing	747-46	1
Boeing	747-47	1
Boeing	747-48	1
Boeing	747-49	1
Boeing	747-50	1
Boeing	747-51	1
Boeing	747-52	1
Boeing	747-53	1
Boeing	747-54	1
Boeing	747-55	1
Boeing	747-56	1
Boeing	747-57	1
Boeing	747-58	1
Boeing	747-59	1
Boeing	747-60	1
Boeing	747-61	1
Boeing	747-62	1
Boeing	747-63	1
Boeing	747-64	1
Boeing	747-65	1
Boeing	747-66	1
Boeing	747-67	1
Boeing	747-68	1
Boeing	747-69	1
Boeing	747-70	1
Boeing	747-71	1
Boeing	747-72	1
Boeing	747-73	1
Boeing	747-74	1
Boeing	747-75	1
Boeing	747-76	1
Boeing	747-77	1
Boeing	747-78	1
Boeing	747-79	1
Boeing	747-80	1
Boeing	747-81	1
Boeing	747-82	1
Boeing	747-83	1
Boeing	747-84	1
Boeing	747-85	1
Boeing	747-86	1
Boeing	747-87	1
Boeing	747-88	1
Boeing	747-89	1
Boeing	747-90	1
Boeing	747-91	1
Boeing	747-92	1
Boeing	747-93	1
Boeing	747-94	1
Boeing	747-95	1
Boeing	747-96	1
Boeing	747-97	1
Boeing	747-98	1
Boeing	747-99	1
Boeing	747-100	1

ELECTRICAL PARTS (Cont.)

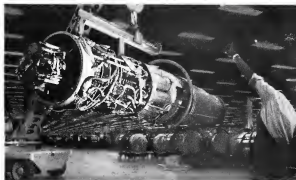
Manufacturer	Mfg. Part No.	Ques.
Boeing	747-1	1
Boeing	747-2	1
Boeing	747-3	1
Boeing	747-4	1
Boeing	747-5	1
Boeing	747-6	1
Boeing	747-7	1
Boeing	747-8	1
Boeing	747-9	1
Boeing	747-10	1
Boeing	747-11	1
Boeing	747-12	1
Boeing	747-13	1
Boeing	747-14	1
Boeing	747-15	1
Boeing	747-16	



ONLY ONE-MAN INTERCEPTOR in operation today, North American F-86D is powered by G-E engine which requires minimum pilot attention.



AUTOMATIC CONTROL of the variable area nozzle (illustrated above) regulates exhaust velocity and temperature.



MOST POWERFUL of J47 family, afterburner version gives F-86D Sabre Jet extra power to climb quickly for interception.

Easy-to-operate G-E Jet Engine Lets Pilot Concentrate on Interception

Electronic "Brain" Permits Complete Engine Control with Single Lever

INSTANT BURSTS OF POWER plus simplicity of operation make G.E.'s J47 with afterburner an outstanding powerplant for high-altitude interception. Powering the North American F-86D, America's first one-man rocket-armed interceptor, the afterburner version of the J47 is equipped with automatic electronic controls. For *any* throttle setting, the controls maintain *optimum engine performance under varying flight conditions*. This allows the pilot to focus his attention on his main job—*seeking out enemy aircraft!*

"SENSORS" FEED INFORMATION pertaining to engine pressure and temperature, air temperature, fuel-flow, and other variables into an electronic "brain." The

brain compares power needs with engine performance. Adjustments, if necessary, are then made *automatically* as the "brain" controls fuel-flow and variable area nozzle on the afterburner.

AUTOMATIC ENGINE CONTROL is supplemented by other features such as anti-icing provisions which are essential to high-altitude interception. These engineering accomplishments have been factored into the J47 by G.E.'s design, development, and manufacturing organization—an organization that is actively proving that "Progress is General Electric's most important product." Section 230-13, General Electric Company, Schenectady 5, N. Y.

You can put your confidence in—

GENERAL  **ELECTRIC**